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U. S. DEPARTMENT OF AGRICULTURE.

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ANNUAL REPORT  
OF THE  
OFFICE OF EXPERIMENT STATIONS

FOR THE YEAR ENDED JUNE 30,



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1908.



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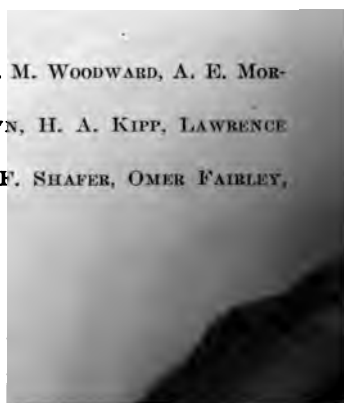
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## LETTER OF TRANSMITTAL.

---

OFFICE OF EXPERIMENT STATIONS,  
*Washington, D. C., April 29, 1908.*

SIR: I have the honor to transmit herewith the annual report of the Office of Experiment Stations, the publication of which is authorized by joint resolution of the Fifty-eighth Congress, second session. This includes a report on the work and expenditures of the agricultural experiment stations established under the act of Congress of March 2, 1887, for the fiscal year ended June 30, 1907, in compliance with the following provision of the act making appropriations for this Department for the said fiscal year:

The Secretary of Agriculture shall prescribe the form of the annual financial statement required by section three of the said act of March second, eighteen hundred and eighty-seven, shall ascertain whether the expenditures under the appropriation hereby made are in accordance with the provisions of the said act, and shall make report thereon to Congress.

There is also a report for the same year on the receipts and expenditures and work of the stations under the act of Congress of March 16, 1906, in accordance with section 5 of that act.

Very respectfully,

A. C. TRUE, *Director.*

HON. JAMES W.  
Sec.



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# ANNUAL REPORT OF THE OFFICE OF EXPERIMENT STATIONS, JUNE 30, 1907.

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## WORK OF THE OFFICE OF EXPERIMENT STATIONS.

The work of the Office of Experiment Stations included during 1907, as it has for several years past, the supervision of the expenditures of Federal funds by the agricultural experiment stations throughout the United States; conferences and correspondence with station officers regarding the management, equipment, and work of the stations; the collection and dissemination of information regarding the progress of agricultural education and research throughout the world by means of technical and popular bulletins; the management of the agricultural experiment stations in Alaska, Hawaii, and Porto Rico; special investigations on the nutrition of man and on irrigation and drainage, conducted largely in cooperation with experiment stations, educational institutions, and other agencies in different States and Territories, and the promotion of the interests of the agricultural colleges and schools and farmers' institutes throughout the United States.

## RELATIONS WITH THE AGRICULTURAL EXPERIMENT STATIONS.

As was expected, the work of the Office in its relations with the experiment stations has been materially increased by the duties involved in the administration of the funds arising from the Adams Act. The policy of the Office with reference to this act is to endeavor to formulate and to hold to such general principles in the administration of the act as seem most likely to secure the efficient use of the funds for research work of a high and substantial character and at the same time to safeguard the autonomy of the stations and raise their work and its results in the estimation of their farmer constituents.

At the request of the Office the stations have submitted outlines of projects to be carried on with this fund. Numerous questions arose as to the nature of the work actually contemplated in connection with these projects, and a large amount of correspondence was had with the stations in the settlement of these questions. An effort has been made to arrive at a clear understanding in advance, in order that the

stations might not be embarrassed by incurring expenses on account of lines of work which could not be approved at the end of the year. The result has been quite satisfactory. The stations now have a quite clear idea of the kind of work which, under the Department's interpretation, can be conducted under the Adams Act, and the decision of the Department to hold the fund for a high order of investigation has received general approval.

The discussions which have followed the passage of the Adams Act have brought out very definitely the great need and opportunity for fundamental investigation in agriculture. It is also more apparent that the more simple and directly practical experiments which have been so popular in the past appeal strongly to local public sentiment and can more readily be supported by State appropriations than advanced investigations.

The plans for the Adams-fund work have been worked out with unusual care and deliberation and, taken as a whole, they embody a large amount of investigation in the true sense, which will place agricultural science and research upon a higher plane. Considering the condition under which the first year's work had to be planned, the difficulty in securing men, the lack of uniform standards, and the diversity of views regarding what constitutes "original research" in agriculture, the programme must be regarded as very satisfactory. Not only has the amount of investigation greatly increased, but the outlining of the various undertakings in advance has also had the effect of systematizing the station work more thoroughly than ever before, and ultimately this should reflect favorably upon the activities of the stations in other lines. If the system inaugurated for the Adams-fund projects shall become more generally applied to the station work as a whole, it will be an important result of the first year's operations under the new act.

This Office has compiled a list of the projects of the several stations, and these projects serve as a basis for the inspection of the work and examination of the accounts. A separate set of vouchers for the Adams fund is required, and it is expected that the relation of each expenditure to these projects can be readily explained. The examination of the work and expenditures now made in connection with the annual inspection has greatly increased the time required for the inspection. Many questions arise which require considerable discussion to settle satisfactorily, and on the other hand the station workers take advantage of the opportunity to inform themselves more thoroughly regarding the Department's attitude toward the Adams-fund work.

The same amount of attention has been given to the work under the Hatch Act as heretofore, and there has been no change in our attitude in regard to the use of that fund.

The Office has continued to follow and record the progress of agricultural experiment stations in foreign countries, and to publish accounts of their organization, resources, and work in the Experiment Station Record and elsewhere, and the steady growth of institutions for agricultural experimentation throughout the world is reflected in the enlarged business of the Office in its relations with the foreign stations. The Office is coming into closer touch with the foreign stations, is getting more regular and complete accounts of their work, and is publishing an increasing amount of information from these sources which is useful to our investigators, teachers, and farmers.

#### INSULAR EXPERIMENT STATIONS.

The lines of work at these stations have not been materially changed during the year. Some new investigations have been taken up and others completed or temporarily postponed, but they were all in continuation of the policy of encouraging diversified agriculture. At each station the diversification of agriculture is recognized as of vital importance to the welfare of the community served. In Alaska pioneer work is necessary to develop agriculture as an industry, and attention is being given at the different stations to some of the more important branches, such as grain growing, stock raising, dairying, orcharding, and gardening. In Hawaii attention is given to industries that will supplement sugar production, the one great agricultural industry of the islands. In Porto Rico the possibilities of the restoration of former industries and the introduction of new ones are being investigated.

As in past years, cooperative work has been carried on between the insular stations and various bureaus of this Department, and acknowledgment is made to each of them for their generous assistance. With the rapid extension of the work at the different stations the work of the Washington office has increased very greatly. This business, as hitherto, has been in charge of Dr. Walter H. Evans, as Chief of Insular Stations.

The following brief summaries will indicate the character and scope of the work during the past year:

#### ALASKA STATIONS.

From the data collected at the various stations in Alaska, wide variation in climate and rainfall is apparent. The coast region, with its comparatively low summer temperature and heavy rainfall, is unsuited to grain growing, while the interior, with its warmer summers and lighter rainfall, seems better adapted to hardy cereals.

The special appropriations for 1906 and 1907 have been expended in the purchase and transportation to Alaska of about forty head of

Galloway cattle. The first year's experience with these animals has shown their adaptability to their new surroundings, and the feasibility of raising cattle, especially of such hardy races, seems assured.

Through the hearty cooperation of the Bureau of Plant Industry of this Department garden and flower seeds were distributed last year to about 2,500 addresses in various parts of Alaska, and this feature of the station work has been continued the present year. In many localities this is the only source from which seed is obtained, and as reports are asked as to the results of planting, much valuable data are obtained regarding the extent to which gardening can be profitably carried on by the settlers.

At the Sitka Station the principal investigations have been, as in previous years, along horticultural lines. The station has distributed more than 12,000 fruit trees and fruit bushes to settlers in different parts of the Territory. The object of this distribution is to give a wide trial to these fruits and to learn as quickly as possible how far fruit growing in Alaska can be successfully prosecuted. The distribution consisted of early maturing varieties of apples, crab apples, plums, cherries, currants, raspberries, gooseberries, strawberries, and a few ornamental perennial plants. All of these have been tested for several years at the Sitka Station and many have fruited.

The work in plant breeding has been continued. There are now at the station about 3,000 hybrid strawberry seedlings, the result of crossing some of the cultivated varieties with the native species. The object of this work is to obtain varieties having the size and productiveness of the cultivated sorts and the hardiness and flavor of the native ones. In a similar way crosses have been made between the cultivated raspberry and the native salmon berry, and something like 500 seedling plants are now under observation. Seedlings from wild and cultivated currants and gooseberries are also being grown, with a view to obtaining more hardy fruits through selection. Advantage has been taken of the presence in southeastern Alaska of a native species of crab apple, and this is being successfully used as stock upon which are grafted a number of the more promising varieties of apples. Some varieties, like Duchess and Okabena, have made good growth when grafted upon the wild stock.

It has already been demonstrated that many varieties of hardy vegetables can be grown throughout the Territory, and the work at the Sitka Station now consists of comparative tests of a few of the leading varieties of potatoes, cabbages, peas, etc. Some varieties of potatoes were grown on an extensive scale, and their adaptability is fully established. The variety Freeman, a potato of medium size and excellent quality, yielded last year 379 bushels per acre, 60 per cent of which were first class in size, ripeness, and quality. Further

experiments have shown that Broad Windsor beans can be successfully grown in Alaska, and the special agent recommends all settlers to grow a few rows of this vegetable in their gardens.

The work at the Kenai Station has been wholly given over to cattle raising and dairying, with enough farming to provide winter forage for the cattle. There were in 1907 one dozen head of pure-bred Galloway cattle and a number of common cows at this station that were fed wholly on forage produced on the station grounds. During the summer the cattle keep in excellent condition by grazing in natural meadows, and for the rest of the year they are fed almost exclusively on grain hay raised on the station grounds. In providing this forage the superintendent worked out a system of haymaking that is well adapted to the moist coast region of Alaska. This method has been fully described in Bulletin No. 3 of the Alaska experiment stations.

Work at the Copper Center Station was begun in 1902, and it has been gradually extended until there are now about 40 acres under cultivation and 80 acres additional fenced for pasture. As has been previously stated, this station is devoted chiefly to experiments in growing grain. Of the four crops produced at this station, only one fully matured, and the others were more or less injured by killing frosts before the grain had matured. Small quantities of different cereals have ripened every year, and these have been saved for selection breeding experiments. In 1906 a very dry spring was followed by early frosts, and little of the grain was matured at the time when a killing frost came, August 24. The standing grain injured by the frost was cut and made into hay, about 22 tons of which was sold at an average price of \$200 per ton. The present season has been an unusually favorable one, and all spring seeding was finished by May 6. Practically every variety of grain ripened its crop.

It is becoming evident that the rainfall of the Copper River Valley is ordinarily not sufficient for growing good crops. The annual precipitation, as shown by the records kept at the station, is only about 10 inches, and its distribution throughout the year is very irregular. There is, however, an abundance of water in the rivers and creeks, and it is hoped that some experiments in irrigation can be begun that will demonstrate the possibility of supplementing the deficient rainfall.

At the Rampart Station considerable progress is reported in preparing land for cropping. Rampart is situated about 1° of latitude from the Arctic Circle, yet there has not been a failure to mature cereals on account of killing frost in the seven years since the establishment of the station. Winter rye and wheat and spring-sown barley and oats have matured their crops. A beginning has been

made in the development of earlier ripening varieties by the selection of the earliest ripening heads of each variety. These are saved for seed purposes, and the selection will be continued until a desired type is secured. Vegetables of nearly all kinds did well in the Yukon Valley the past season.

Preliminary to the opening of the Fairbanks Station an equipment of tools and implements was forwarded to that place and some work in clearing land and seeding fall grains begun. The details of the work at this station have not been fully decided upon. The station is located not far from the center of the Tanana Valley, and it is estimated that this valley contains not less than 15,000 square miles of agricultural lands. There is a large population in this valley on account of the extensive placer mines along the various creeks tributary to the Tanana, and it is believed to be of great importance that agricultural experiments should be prosecuted with vigor for the benefit of the present and future settlers.

In making appropriations for the Alaska experiment stations in 1906 and 1907 the Congress granted \$3,000 each year for the purchase and introduction of live stock for experimental purposes. The funds thus appropriated have been expended in the purchase and shipping to Alaska of about forty head of Galloway cattle. It is deemed very important for the future of the agricultural interests of Alaska that a hardy breed of cattle should be introduced and bred in the Territory. The Galloway cattle were chosen as best suited to the conditions, as it is a hardy race. In selecting the cattle preference was given to those cows having the best milk records, and it is hoped that it will be possible to develop from them a dual-purpose animal.

In 1906 about a dozen head were purchased, most of which were sent to the Kenai Station, although a few were placed temporarily on Wood Island, near Kodiak. In the spring of 1907 twenty more were purchased and sent to Kodiak, where it is intended to establish a breeding station upon the tract reserved by Executive proclamation on March 28, 1898. As yet no buildings have been erected, nor have much-needed fences been constructed. It is expected that these will soon be provided, after which the cattle from Kenai and Wood Island will be brought to Kodiak. So far as the conditions for cattle raising are concerned, there is little difference between Kenai and Kodiak, but the accessibility of the latter place, it is believed, will warrant the consolidation of this work at one place.

As soon as funds are available it is proposed to add one or two hardy breeds of sheep to the live stock at this station, and ultimately to introduce the Shetland and Iceland ponies, as it is believed that this would be an ideal place for their breeding.

**HAWAII STATION.**

The routine, office, library, and laboratory work of the Hawaii Station has been continued along about the same lines as previously described. The new water system provided for by Congress has been installed, and this guarantees fire protection to the station residences and office buildings and insures a water supply to the experimental plats during the hottest and driest months of the summer, a period during which there has been in previous years a shortage in the city water supply.

The distribution of Bluefields bananas begun in May, 1906, was continued during July and August, and more than 1,000 suckers of this fine type of banana have been distributed by the station throughout the Territory.

A considerable supply of cacao seedlings and some inarched mangoes were received from the Bureau of Plant Industry of this Department, and a portion of them were planted on the station grounds, while the remainder were placed at Hilo, where previous plantings of cacao had been made.

By cooperative agreement between the Office of Experiment Stations and the Bureau of Plant Industry, Dr. N. A. Cobb, who was previously pathologist of the Hawaiian Sugar Planters' Station, made a study of fungus diseases of crops other than cane in Hawaii, and a report upon this subject will be issued as a bulletin of the station.

The special agent has visited a number of different portions of the islands securing data in reference to the development of the rubber industry, the growing of grapes, sisal production, etc.

Considerable work has been done by the station for other branches of both the Federal and the Territorial governments, including cement analyses for the United States Army Engineer Corps and a number of analyses and examinations of imported goods for the collector of customs, and it has also cooperated with the United States Navy Department in sending collections of seeds and plants to the naval stations in Guam, Tutuila, and the Philippines.

Besides the regular appropriation provided by the Congress, the station during the fiscal year 1907 received from private individuals, the Territorial government, and corporations \$13,518 for carrying on specific investigations. This sum was largely used to assist in the rice, tobacco, and rubber experiments. Contributions were made to assist the entomologist in making a study of honey and of insects affecting stock.

In addition to a considerable amount of routine work the chemist, in cooperation with the entomologist, made analyses of forty-nine samples of honey of known derivation.



The station has continued its tobacco investigations, concerning which a number of reports have been issued. In January, 1906, a tract of land on the island of Hawaii was placed at the disposition of the station by the acting governor, reserving it for station use for a period of three years. Field work was begun in February, a part of the land cleared of abandoned coffee, and 2 or 3 acres prepared for immediate planting. The work was begun so late in the year that only about  $3\frac{1}{2}$  acres were planted. A curing barn capable of handling 5 acres of tobacco was completed, but with all the haste exercised a portion of the crop was lost by being overripe. The results obtained were better than in any previous season. The entire crop was cured and fermented in the new tobacco barn, and although a portion was lost from overripeness a crop of 3,000 pounds of cured tobacco was secured from  $3\frac{1}{2}$  acres of land. Some six or seven bales of this has been distributed in small amounts to tobacco dealers in the United States and Europe, and the station has now on hand twenty-three bales of finished tobacco. The best tobacco grown this year was of the Sumatra type, although the Cuban grades were of excellent quality. The reports in regard to the quality of the station tobacco are almost uniformly favorable, buyers being enthusiastic in regard to the color, texture, and burn of the leaf. It is believed that the station has definitely established the fact that cigar-leaf tobacco can be profitably produced on a commercial scale in favorable districts in Hawaii.

Work on the distribution of "top minnows" as a means of controlling mosquitoes was completed during the year, and an investigation was made of a serious outbreak of pineapple insects upon the island of Kauai. The cause of serious losses among fields of newly set pines was found to be the pineapple scale and the pineapple mealy bug. Experiments in dipping and fumigating suckers showed that the hydrocyanic-gas method was cheap, easy of application, and entirely efficient.

The principal line of work of the entomologist during the past year has been the problems connected with the honey industry in Hawaii. Hawaiian honeys are largely of a type different from those produced on the mainland. The annual production amounts to about 600 tons, one-fourth of which is designated as honeydew honey, the source of which is not floral nectar, but the secretions of insects attacking sugar cane and other sugar-producing plants. The analyses of the Hawaiian honeys made by the chemist of the station plainly indicated that these honeys are not artificially adulterated. In connection with the honey work, an investigation has been begun on the feasibility of feeding back inferior grades of pure and mixed honey for the production of wax. Miscellaneous investigations have been

begun on the insects affecting live stock, household pests, insects affecting stored products, etc.

The principal investigations of the horticulturist have been along the line of fruit shipment. Early in 1906 he accompanied a large shipment of fruit to the Pacific coast, the object being to determine the best methods of packing, handling, and marketing tropical fruits. About 4 tons of pineapples, avocados, papayas, and bananas were shipped to San Francisco, from which point they were transshipped to various cities along the coast. Selected packages were also forwarded to commercial bodies of each of the mountain States as far east as Colorado. The experiment demonstrated the possibility of the shipment of avocados and mangoes in cold storage to any point that can be reached directly by shipment from Honolulu, Hilo, or other island ports. Many interesting facts were determined in regard to the methods of handling, packing, and the use of different styles of crates. One of the most striking features of the experiment was the demonstration of the value of fumigation with formaldehyde gas to control losses caused by the pineapple rot (*Thielaviopsis ethacetica*). Preliminary experiments were made in dipping and fumigating fruits with formaldehyde, and it was demonstrated that a favorable method of fumigation is that proposed by the Maine State board of health, which consists of the use of permanganate of potash and commercial formalin. Other points determined were the value of glazed paper as a packing material for fruit and the value of wrapping the fruit as compared with packing it in hay or straw. A detailed account of these experiments has been issued as Bulletin 14 of the station. These experiments were continued in 1907 and successful shipments were made as far east as Chicago.

The permanent orchards of the station were largely increased during 1907. The avocado and mango orchards now occupy  $1\frac{1}{2}$  acres, in which are planted budded, grafted, and inarched stock of many of the best varieties. About 2 acres of land has been cleared on the upper portion of the station grounds and planted with the best California varieties of citrus fruits, figs, loquats, and grapes. About one-third of an acre has been planted with papayas for experiments in crossing and breeding, and a large number of citrus seedlings have been set with a view to making a collection of the best island types. On the lower part of the station grounds 4 acres have been planted to mulberries, citrus fruits, five species of rubber, and a miscellaneous collection of tropical fruits.

The horticulturist supervised the setting out, on a large ranch on the island of Hawaii, of two deciduous orchards, consisting of apples, pears, plums, peaches, apricots, cherries, walnuts, almonds, and figs. One of these orchards is located at an elevation of 3,000 feet and the

other at 5,000 feet, and it is believed that this cooperative experiment will prove of great value in subsequent years.

During the summer of 1906 attention was called to the existence of two small groves of rubber trees on the island of Kauai, each containing about 100 individual trees. One of these groves was planted in 1893, and from seed produced in this grove the second was planted in 1899. The trees were of the Ceara variety, which is being extensively planted in Hawaii. It was suggested by some of the planters that the station undertake some tapping experiments, and the preliminary work was done on a few isolated trees on the station grounds in Honolulu. A number of systems of tapping were investigated, and the half herring-bone system, with one vertical cut and laterals a foot apart, proved best.

As the latex from this species coagulates almost at once when the channels are made, a method of trickling water down over the cut surfaces was adopted, and it was soon found that the addition of ammonia retarded coagulation and caused the flow to continue until the feeding area was practically exhausted. Tappings were begun at 5 o'clock in the morning, and two trees, averaging 28 inches in circumference, were tapped for nine consecutive days with the full herring-bone system from the ground to 5 feet, yielding 8 ounces of dry rubber in nine days. Two other trees tapped on alternate days for a period of two weeks yielded 4 ounces of dry rubber in that time. In the other grove, where the trees were 13 years old, two trees, 34 inches in circumference, tapped every day for nine days, yielded 12½ ounces of dry rubber. As these trees were almost bare of leaves and the resting period about ended, it was not considered advisable to tap on alternate days. A number of 4-year-old trees, 19 inches in circumference, that were entirely bare were tapped every day for nine days and yielded only one-half ounce of dry rubber.

These preliminary experiments have been very suggestive, and many points have arisen that the station will endeavor to work out during the coming year.

The investigations of the problems of the rice industry begun in July, 1906, have been continued, a considerable portion of the funds to meet the expense of which was contributed by certain estates interested in rice production. Through the cooperation of the Bureau of Plant Industry of this Department and through the bureau of agriculture of the Philippines, about 130 different varieties of rice were obtained and in addition the best strains of Hawaiian rice were used for the experiments. The results of the variety tests have shown that one variety, which was originally obtained in Egypt, has proved to be better than any rice grown in the islands. In addition to this Egyptian type three other strains have shown marked superiority over the ordinary Hawaiian-grown rices. These are, in order of merit, a

Philippine variety, a strain of Gold Seed received from Georgia, and a Japanese variety secured directly from Japan. The Japanese variety produces a crop in three-fourths the time required for the maturity of the Hawaiian variety. This type of rice is largely consumed by the Japanese laborers and yields heavily and mills well. By the adoption of this variety two crops can be grown each year, with a considerable rest between the crops that will permit of the drainage of the fields and their better tillage and preparation. A number of selections have been made of individual plants of Hawaiian rice, and an increase of 25 per cent in the yield of paddy has already been produced by two selections from individual plants.

Three varieties of dry-land rice have been selected from the original variety collection, and it has been determined that these rices produce a better crop without irrigation than with it. One of the principal values of the dry-land rice is its production of forage, and the present outlook is that dry-land rices will fill a very important need in Hawaii in the production of grain hay and forage.

Fertilizer experiments have shown that an increase of 15 to 20 per cent of grain per acre can be secured by the use of proper commercial fertilizers.

In connection with the rice experiments tests were made of a number of types of machinery not hitherto used by rice growers in Hawaii. These included disk tillage implements and twine binders, and it was found that  $4\frac{1}{2}$  acres of land could be plowed in a day with a 5-foot cut-away bog plow with four horses, as against from 1 to  $1\frac{1}{2}$  acres with two water buffalo or three or four horses with an ordinary 10-inch plow. The results of the preliminary harvesting test indicated that with the comparatively heavy machine used a good team of two heavy draft horses or three or four medium horses and three men could do the work now requiring 25 to 40 men.

#### PORTO RICO STATION.

The Porto Rico Station has given assistance to planters in importing live stock and has also distributed by sale a number of pigs, chickens, ducks, geese, and turkeys, as well as eggs of the different classes of poultry.

Although the station is not in what is recognized as the tobacco district of the island, experiments have been carried on with some of the coarser types, and the White Burley and Zimmer Spanish have been found to succeed very well. Studies have been made of the insects affecting the tobacco plant and means for combating them. The station entomologist discovered a parasite of the tobacco hornworm, which he has propagated and distributed among the tobacco plantations of the island.

The coffee substation at La Carmelita is showing the beneficial results of better methods of planting and cultivation. This is evidenced not only in the increased yield of the trees, but in their more thrifty condition. That the work of the coffee substation is appreciated by the planters is shown throughout that section of the island, where seed beds are now planted and improved methods of culture are seen on every hand. Varieties of coffee introduced by the station have fruited sparingly, and during the coming season a number of Java and other coffees are expected to produce a crop sufficient to give an idea as to their value and flavor when grown under Porto Rico conditions. A number of other varieties of coffee have been received, among them a collection that was furnished to the station from the French Colonial Gardens at Nogent-sur-Marne.

The first crop from the experiments with sugar cane has been harvested. These experiments included trials in distance of planting and methods of cultivation and fertilization of the cane. About 30 varieties of seedlings and other canes are under observation, and small quantities of a number of the more promising ones have been distributed to various sections of the island. A number of leguminous plants are under experiment as green manures for cane. These are planted to follow the cane crop in rotation and also among the rows of cane, with a view to improving conditions where cane is grown continuously on the same soil.

Rice continues to be by far the greatest import of the island of Porto Rico. The growing of upland rice is increasing to a small extent, and lowland rice cultivation is as yet a thing of the future. Many soils now devoted to cane could be very profitably given over to rice production, especially where irrigation plants have been installed. In the growing of rice the experiment station has tested a number of varieties of lowland rice with good results.

From funds appropriated by the insular government the station has imported about 100,000 suckers of sisal plants, which are being sold to the planters at cost. From specimens grown by the experiment station a very fine quality of fiber has been extracted. Many soils in the island are adapted to the growth of sisal, and planters are taking great interest in it.

A number of factories have been established in towns in the western end of the island for the manufacture of Panama hats. The raw fiber is imported, and after weaving the finished product is shipped to the States. The station, through the American consul at Guayaquil, Ecuador, has secured a number of these palm-like plants, and it is hoped in a short time that it will be able to distribute them among weavers, in order that the raw material may be produced at home.

Forestry plantings are being continued at the station with a view to determining the best methods of utilizing the bare hills now in

many sections of Porto Rico where coffee was once grown and on lands that have become nonproductive. It has been found necessary to change the methods of afforesting. In the forest plat at the station the economic trees, with one exception, failed to make a satisfactory growth. At present plantations are being started with trees, especially leguminous ones, that will grow under adverse conditions. After the ground has been sufficiently covered, trees of greater economic value will be set out. This method appears to offer promising results.

The fruit industry of Porto Rico has had quite an impetus during the past year. Early shipments of oranges and pineapples to the New York market proved very successful, and this has induced extended plantings, especially of pineapples.

Among pineapples the Cabezona and the Red Spanish are the only ones that the station feels warranted in recommending for commercial plantings. Others are promising, but have not yet given entirely satisfactory results. The Red Spanish variety seems best adapted to sandy soils, while the Cabezona thrives on the heavier lands on the western coast. The station's experiments in shipping the Cabezona pine, which has not hitherto been considered a good keeping fruit, have been so successful that where accessible to shipping points this variety is now being exported in large quantities.

One fact that has been demonstrated in the culture of citrus fruits is the importance of wind-breaks, and during the past year there have been trials of different plants for this object. The plants that have been tried for wind-breaks are gandules (pigeon peas), sugar cane, and bananas. For permanent wind-breaks the station recommends the planting of leguminous trees, or where trees of economic value are wanted the planting of mangoes is advised. A number of fertilizer experiments in citrus orchards are being carried on in cooperation with planters in different parts of the island.

The special agent is very much impressed with the value of the Indian mango as a fruit for Porto Rico, and the station has about 50 trees and is propagating others as rapidly as possible. It is hoped during the coming year to distribute a few trees here and there so that fruit growers may inarch their own trees. This method of propagation is very slow, as it takes several months for a union to be formed where the trees are inarched.

Many of the cacao trees planted at the station have begun to bear fruit, but a great drawback to the industry is a fungus disease of the pods that causes them to dry up on the tree. Until investigations show some method of combating this trouble, the commercial planting of this tree can not be advised.

A number of other fruits are under trial, some of which have proved successful experimentally, but further work will be necessary

before the planting of such fruits as grapes, peaches, etc., can be recommended.

During the past year the time of the entomologist has been largely taken up with methods for the eradication of scale insects on citrus trees and the destruction of insects of tobacco and sugar cane. A large number of insects have been added to the collection of the station and the life history of many of them is being studied.

The outlook of the station is very bright and planters are learning to appreciate more and more the efforts that are being made for their betterment. The calls for assistance are greater and the number of visitors to the station from distant sections of the island is increasing rapidly.

### NUTRITION INVESTIGATIONS.

The study of the utilization of grains, dairy products, meats, and other agricultural food products of animal and vegetable origin is an important branch of agricultural research. The nutrition investigations carried on by this Office during the past year in continuation of earlier work had for their object the accumulation of information upon this general subject. The policy of cooperation with agricultural colleges, experiment stations, and other institutions has been followed as heretofore, as this plan has proved economical and productive of large results in proportion to the Department funds available for such lines of investigation. The cooperating institutions contribute in many cases money and in practically all cases the use of laboratories, chemicals, apparatus, libraries, the advice and counsel of skilled experts, and similar assistance. The value of association with the Department in such work is generally recognized by the cooperating institutions, as is shown by their readiness to continue the work and by numerous opportunities which arise for extending the work should Department funds permit.

As a result of the nutrition investigations a large contribution has been made to the general fund of information regarding the comparative nutritive value of different foods supplied by the farm, dairy, ranch, and garden; the rational use of these foods and their manufactured products; the digestibility of different foods; effect of methods of cooking and preparation for the table upon nutritive value; the demands of the body for food as influenced by age, sex, and muscular activity, and many other questions bearing directly upon the production and utilization of food and upon the proper preparation and use of food in the home.

When the nutrition investigations were first instituted some twenty years ago the subject was a comparatively new one and little information was available regarding experimental methods. As a part of the systematic investigations carried on under the auspices of this

Office important laboratory methods have been perfected and apparatus has been devised, the most noteworthy being the respiration calorimeter for studying the income and outgo of matter and energy of man, and the bomb calorimeter for studying the energy value of food and other materials. Owing to this elaboration of methods and perfection of apparatus it is now possible to accumulate results much more readily than in times past.

The importance of instruction in various lines which pertain to the general subject of food and nutrition is each year more fully appreciated, as is shown by the increasing number of high schools which give courses in the preparation of food and other questions relating to nutrition and by the prominence which this subject is given in institutions for higher education. There are at the present time in the United States some 200 agricultural colleges, State universities, normal schools, and other institutions for the higher education of women which include this work in their curriculums. The Department of Agriculture is in close touch with all these institutions and, therefore, the subject of the pedagogics of nutrition has been included with other work on the subject.

In conducting the nutrition investigations for the past year attention has been paid particularly to dietary studies, cooking experiments, studies of the digestibility of food prepared in different ways and served in different combinations, studies of the ash constituents of food, and the proportions of different mineral elements required in the diet.

#### THE WORK AT DIFFERENT PLACES.

In Washington the nutrition division of this Office has had general supervision of the plans and expenditures for the cooperative investigations and has performed special duties in connection with the enterprise. Dr. C. F. Langworthy, as chief of nutrition investigations, has had charge of the work. At the request of members of Congress and of different branches of the General Government, data regarding various questions of food and nutrition have been collected. Students and teachers, physicians, heads of public institutions, and home makers on farms and in towns make large demands for information on various questions concerned with the relative value of different foods, and, so far as possible, information has been supplied by distributing publications and by correspondence.

Attention has been paid, as heretofore, to the collection of bibliographical and other data relating to food, and to editing reports of nutrition investigations; to the preparation of abstracts of current literature of the subject for the Experiment Station Record; and to the preparation of popular summaries of nutrition work, particularly that carried on at the experiment stations, for publication in the series of bulletins entitled "Experiment Station Work."



Requests are frequently received from schools, learned societies, etc., for lectures or for informal discussions on different topics connected with the general subject of nutrition, and these requests have been complied with so far as possible.

As a part of the work of the nutrition division of the Office a number of technical and Farmers' Bulletins have been prepared for publication, as well as a number of reports and summaries. Under the immediate supervision of the Office investigations have been conducted at Wellesley College, at the School of Education of the University of Chicago, and at Drexel Institute, Philadelphia. Special attention has also been paid to collecting data on the pedagogics of nutrition and to systematizing available information in such form that it will be readily accessible for the use of teachers in agricultural colleges and other institutions.

Prof. M. E. Jaffa and his associates at the University of California have studied the digestibility and nutritive value of fruits and nuts in different combinations with other foods in continuation of the work of former years. Fruits and nuts and their products have constituted an integral part of a simple mixed diet in these investigations, and special attention has been paid to determining the proportions of nutrients which may be supplied by these foods and the thoroughness with which the body can utilize them. The California investigations as a whole have shown that fruits and fruit products may readily supply a considerable part of the total energy of the diet and that nuts may be regarded as a reasonable source of both protein and energy when their use seems desirable.

Little information was available regarding the digestibility and nutritive value of fruits and nuts until the investigations in California were undertaken, and the results obtained have been of very great interest and value to consumers, fruit and nut growers, and manufacturers of fruit and nut products.

At Wesleyan University, Middletown, Conn., Prof. F. G. Benedict and his associates planned to carry on a number of investigations with the respiration calorimeter on the heat and carbon dioxide output and the oxygen intake of persons differing in height, weight, and other physical characteristics, and to continue the studies begun last year in cooperation with the Bureau of Animal Industry and this Office on the nutritive value of cheese. For some time the Carnegie Institution of Washington has carried on nutrition investigations at Middletown, which supplemented and extended the work of the Department. During the year the Carnegie Institution made public its plan to establish a laboratory of nutrition investigations at Boston, and Professor Benedict accepted a call to the directorship of this laboratory. In view of this fact, it was deemed best to give preference during the past year to the preparation in bulletin form

of the large amount of material which had accumulated from earlier investigations at Middletown, not yet reported, and as a result of this work three reports have been prepared. The first deals with the output of carbon dioxide and heat and the intake of oxygen in different conditions of mental work and rest; the second, with income and outgo of carbon dioxide and heat and the intake of oxygen under different conditions of muscular work; and the third reports the results of one hundred and eighty-four experiments on the digestibility and nutritive value of cheese as well as of five respiration calorimeter experiments in which the value of cheese as a source of energy was studied.

From the elaborate experiments reported it does not appear that mental work exercises a positive influence on metabolic activity—that is, on the amount of oxygen consumed and the carbon dioxide and energy given off from the body.

The cooperative experiments on the digestibility of cheese which it was planned to carry on at Middletown were later undertaken at the Minnesota Agricultural College and Experiment Station.

Considerable material is already in hand which reports the results of dietary studies undertaken at the Hawaiian Experiment Station to learn the kinds and amounts of foods consumed by natives and other residents of Hawaii, but it was not found convenient to undertake additional experiments during the past fiscal year. Though they can not properly be called a part of the cooperative nutrition investigations, it is interesting to note that studies of the nutritive value and use of such foods as marine algæ were undertaken at the Hawaiian Station by Miss Minnie Reed.

At the University of Illinois Prof. H. S. Grindley and his associates have carried on forty-five artificial digestion experiments with different kinds and cuts of meat to study the effects of different methods of cooking on ease and rapidity of digestion, and have also made cooking experiments which were undertaken to secure additional information regarding the changes and losses sustained by meat when cooked in different ways. As a whole, the work at the University of Illinois has shown that it is possible to control cooking processes so that uniform results may be obtained. Meats of all kinds and cuts are to be ranked among the very digestible foods. No great differences were observed in the ease or thoroughness of digestion of different kinds and cuts of meat.

At the School of Education of the University of Chicago, Mrs. Alice P. Norton and her associates have studied the effects of different methods of cooking upon the character and appearance of fruit juice and upon the yield and character of the cooked product. The experiments indicate that when sugar is added to fruit at the close of the cooking period much less is inverted than is the case when it is

cooked with the fruit. In the case of apples there was no marked difference in the sweetness of samples with sugar added before and after the cooking period. Apples cooked in water with and without sugar were less acid than the uncooked fruit. It was found that jelly could be made from fruits (currants, grapes, and plums) without the addition of sugar, but the yield was so small that the jelly would be very expensive. The addition of sugar markedly increased the yield. Jelly with small amounts of sugar kept as well as that made with larger amounts.

At the Maine Agricultural Experiment Station, Director Charles D. Woods and L. H. Merrill have continued their studies of cereal products, paying particular attention to corn, and have made twenty-five digestion experiments with modern-process white granular corn meal prepared for the table in different ways. The determination of crude fiber in feces is a subject which presents a number of difficulties, and this question was especially considered in connection with the digestion experiments, as was also the determination of the metabolic nitrogen in the feces.

The general purpose of the work carried on at the Maine Station was to ascertain whether or not differences existed in the digestibility and nutritive value of corn meal ground in different ways which could be attributed to the method of grinding. It is well known that different methods of manipulation are required to secure the same dishes with old-fashioned water-ground corn meal and with products of modern mills. While data at present available are perhaps too limited for final deductions they do not indicate that there are any appreciable differences in the nutritive value of breads of different sorts made from the two sorts of corn meal. As a whole, corn-meal bread has about the same digestibility as bread from the coarser sorts of wheat flour, and may be ranked with the more thoroughly digestible vegetable foods. When its wholesomeness and palatability are also taken into account, the conclusions are warranted that corn meal justifies its reputation as a very valuable foodstuff and deserves even more extended use than it at present receives.

At Wellesley College, Wellesley, Mass., Prof. Charlotte Bragg has continued her investigations on the relative merits of different household methods of canning and preserving vegetables, and has found that although corn, peas, beans, and other common garden vegetables may be canned at home, they differ as to the ease with which this may be successfully accomplished. Methods have been elaborated which are suitable for the different classes of vegetables, and it is expected that the results, together with those of earlier investigations along similar lines by Miss Isabel F. Hyams, of the Massachusetts Institute of Technology, will be published in bulletin form.

Investigations on the nutritive value of cereal foods as a class have been continued at the University of Minnesota and the Minnesota Agricultural Experiment Station by Prof. Harry Snyder, who has made twenty-four experiments to determine the digestibility and nutritive value of flour in the form of cookies, buns, crackers, and similar foods—that is, flour in somewhat more complex forms than bread. Fifteen digestion experiments with bread made from bleached and unbleached flour, and sixteen digestion experiments on the effects of different methods of combining bread and other foods upon the digestibility of an entire ration were made. In addition to this work Professor Snyder has made, in cooperation with the Bureau of Animal Industry and this Office, forty experiments on the digestibility and nutritive value of cheese of different kinds and of different stages of ripeness. In all this work the income and outgo of nitrogen have been determined.

The studies with flour products other than bread have, in general, indicated that these foods are rather thoroughly assimilated and agree closely in digestibility with bread made from flour of the same sort. In other words, neither the addition of some sugar, butter, etc., as in making cookies and similar foods, nor an entirely different method of manipulation, as in making crackers, had any material effect upon the digestibility of flour when compared with bread as a standard.

From the experiments with old well-cured, with green, with skim milk, and with Swiss, Camembert, and Roquefort cheeses, the conclusion was drawn that all these forms of cheese have a high degree of digestibility. Little difference was observed in the thoroughness of digestion of old well-cured and of new cheese, ripening having a greater effect upon flavor than upon digestibility. There was apparently little difference in the thoroughness of digestion of large or small amounts of cheese, nor were marked differences observed with respect to the digestibility of the different sorts tested. None of the subjects experienced any difficulty with the prolonged cheese diet, and no digestive disorders were observed in the use of cheese in large amounts. As a whole, the investigation demonstrates the high value of cheese as an article of diet.

Prof. Edna Day, head of the domestic science department of the University of Missouri, at Columbia, has for some time been engaged in a study, by microscopical methods, of the comparative digestibility of raw and cooked starch from different sorts of cereals and vegetables. This Office has cooperated with Doctor Day in outlining the work and has assisted in other ways, and the report of her investigations will be published as one of the bulletins reporting the results of nutrition investigations.

Metabolism experiments, in which the income and outgo of calcium, magnesium, and phosphorus were specially studied, have been the principal features of the work on the ash constituents of food carried on at Columbia University, New York, under the direction of Prof. H. C. Sherman. As a part of this work experimental dietary studies were undertaken with a view to ascertaining the relative importance of different kinds of food materials for supplying these constituents in a needed amount and the relative economy of different food materials as sources of mineral constituents of the diet. A bulletin has been prepared reporting the results of these investigations.

At Teachers' College, Columbia University, Miss Louise Stanley has made a study of the culinary qualities of old-fashioned water-ground corn meal in comparison with other sorts of corn meal, and has summarized data on the methods of manipulating corn meal in order to secure food products of uniform quality.

Miss Alice Ober, under Miss Kinne's direction, has collected and systematized a large amount of information regarding the courses in home economics, and particularly in food and nutrition, given in American agricultural colleges and other institutions of collegiate grade.

Miss Emma Smedley, of Drexel Institute, Philadelphia, Pa., co-operating with this Office, has carried on a dietary study in a large home for aged women in Philadelphia and in a similar institution near Philadelphia for children.

Owing to the pressure of other work, Prof. C. E. Wait, of the University of Tennessee, could not conduct the proposed studies of the kinds and amounts of food used in public institutions in and near Knoxville. Attention was, however, devoted to the preparation for publication of the reports of earlier investigations, and a bulletin has been published on the digestibility and nutritive value of dried legumes. A bulletin reporting the results of dietary studies of families living in the mountain regions of Tennessee has been edited and awaits publication.

#### PUBLICATIONS.

The results of the nutrition investigations are published in technical bulletins, of which 53 have been issued since the work was first begun. General deductions of popular interest which can be drawn from the investigations are summarized, together with other similar matter in Farmers' Bulletins and other popular publications. Of these 35 have been issued, as well as numerous reports of progress and similar articles.

The nutrition publications issued during the past year have included 3 technical bulletins, 3 Farmers' Bulletins, a Yearbook article, special articles and general summaries for the annual report

of the Office of Experiment Stations, and similar reports. The subjects treated in these publications are as follows: Experiments on the metabolism of matter and energy in the human body, 1903-4; Iron in food and its functions in nutrition; Studies of the digestibility and nutritive value of legumes at the University of Tennessee, 1901-1905; Use of fruit as food; Potatoes and other root crops as food; Food value of corn and its products; Nuts and their uses as food, and Some experiment station work relating to the food and nutrition of man.

In addition to the above, 3 technical bulletins and 1 Farmers' Bulletin have been prepared for the press and await publication.

### **IRRIGATION AND DRAINAGE INVESTIGATIONS.**

The organization of Irrigation and Drainage Investigations of this Office during the fiscal year 1907 remained the same as during the previous year, with Dr. Elwood Mead as chief, C. G. Elliott as chief drainage engineer, and R. P. Teele in charge of publications. Soon after the end of the year, however, Doctor Mead resigned to take up similar work with the government of Victoria, Australia. Upon his retirement the work in irrigation and drainage, which had been under his direction, was separated and Dr. Samuel Fortier, who had been in charge of work in California, was made Chief of Irrigation Investigations, and Mr. C. G. Elliott, formerly chief drainage engineer, was made Chief of Drainage Investigations.

### **IRRIGATION INVESTIGATIONS.**

The last five years have witnessed a great demand for western land, which has resulted in bringing about half as much land under ditch as had been reclaimed by irrigation in the preceding half century, and in the settlement of large areas on the semiarid plains, while the same influence has called for a larger and better use of lands already under cultivation. This rapid settlement of the section where the rainfall is insufficient for the growing of profitable crops has changed somewhat the relative importance of the lines of work carried on by the Irrigation Investigations of this Office, calling for more attention to the needs of these new sections, thus limiting the amount which could be expended in investigating the problems of the regions which have been in cultivation longer.

The settlement of the semiarid plains, which has been so noticeable for several years, has continued without check during the past year. The dangers of such settlement without some provision for irrigation have been pointed out in previous reports. The experience of the past season has confirmed the belief that only a few of the settlers who are taking up lands on the plains can maintain their homes

there without irrigating at least small portions of their land holdings. Several stations have been established and are being maintained by the Office, namely, at Cheyenne and Newcastle, Wyo., and Eads, Colo., for the purpose of determining the best methods of securing small water supplies, the cost of such supplies, and the methods by which the largest returns can be secured from the use of the water. A part of the land at each station has been cropped without irrigation for purposes of comparison. Results of a single season from such stations are not conclusive, but these stations will furnish data as to quantity of water which may be expected from wells and torrential streams, the cost of pumping or storing, the efficiency of different types of windmills, engines, and pumps, the methods and cost of building and lining small reservoirs, the methods and cost of applying the water to crops, and the returns which may be obtained. These stations are in the heart of the "dry-farming" region, and while the results will be made available to settlers chiefly through bulletins giving the results secured, they serve also as demonstrations, the number of visitors to the stations during the past season having been very large. The realization of the necessity for irrigation in connection with dry farming or stock raising is growing, and with it the value of the work being done at these stations.

For the next few years it is believed the largest field for usefulness open to the Office will be in furnishing practical information to beginners in irrigation. It is estimated that through the activities of the Reclamation Service and private parties there will be in the year 1908 about 5,000,000 acres under ditch and ready for settlement. In addition to the usual expense and labor of reclaiming new land, the settlers taking these lands will be burdened with the work of clearing and leveling their land, laying out and building farm ditches, and applying water to crops, with all of which they are unfamiliar. They must also pay for the works supplying them with water. With this heavy load there is little room for experimenting or for mistakes which consume time and money and delay the securing of crops. Irrigation farming is a highly capitalized form of agriculture, and failure is therefore more disastrous. The realization of this by both canal builders and settlers is creating a great demand for practical information as to how to perform all the agricultural operations connected with irrigation. The Office is striving to meet this demand in a number of ways. It has begun the publishing of a series of bulletins covering these operations; its field men give personal advice wherever called upon, and it has an agreement with the Reclamation Service and the Bureaus of Plant Industry and Soils for the establishment of demonstration farms on the projects of the Reclamation Service. The demand for such work as this will probably increase for a number of years, as construction

is going on steadily. The success of every irrigation enterprise depends ultimately upon the success of the farmers using the water, and therefore this work benefits the capitalist and the community at large fully as much as it does the farmer.

To the west of the Rocky Mountains, in the great valleys of the Pacific slope, the great demand is for irrigation, to make it possible to farm at a profit lands which have been exhausted by wheat growing. To meet this demand the Office has been studying the irrigation possibilities of the Sacramento and Willamette valleys.

In the Willamette Valley the annual rainfall is heavy, but the average rainfall between June 15 and September 15 is but 2.5 inches, making it impossible to raise without irrigation crops whose normal growing period extends through this dry season. Since some kinds of farming can be carried on without irrigation the farmers are slow to adopt irrigation until its practicability has been demonstrated. In cooperation with local farmers the Office has been carrying on experiments to provide this practical demonstration. One of the great needs of this region is forage. Without irrigation clover makes no crop the first year after planting and but one crop in subsequent years, but this year on one of the experimental irrigated plats, seeded in February, two good crops were secured and a good growth was made after the second crop. Irrigated onions showed an increase of 145 per cent over those not irrigated, while irrigated potatoes showed an increase of 188 per cent over the unirrigated, or 125 bushels to the acre. Very large areas in this valley are planted to hops. Experiments the past year showed an increase of 80 per cent in the hop yield, due to irrigation. It is realized that such experiments must cover several years in order to eliminate the effects of conditions peculiar to a single season, but the showing for the past season encourages further effort in this direction. There is every reason to believe that there will be a rapid extension of irrigation in this valley and in others similarly located. This will greatly increase the demand on this Office for information as to pumping, preparing land, applying water, etc.

During the past few years the Sacramento Valley of California has been undergoing radical changes. The large estates containing from 5,000 to 20,000 acres are being subdivided, capital is being expended in the construction of irrigation works, and a concerted effort is being made to convert the dry farms on an area of over 2,000,000 acres into small irrigated holdings. The purpose of the work done in this valley in 1907 was to obtain correct views of the conditions and possibilities of this field and to point out the proper methods to adopt in irrigation in a region possessing a heavy winter rainfall, followed by a period of five months when little or no rain falls.

The work so far described relates entirely to territories just coming under irrigation. This has been mentioned first because the greatest



demands for help are coming from these sections. The problems are all those of a new country. The information supplied to these sections must largely come from the older irrigation regions.

However, the older sections have problems of their own. In the newer sections natural resources are abundant, and economy of time, labor, and money are the important things. In many of the older communities the limit of the water supply has been reached, and future agricultural extension depends upon more economical use of water and the stopping of wastes of all kinds.

Measurements made by this Office and by others show that not more than one-half the water diverted from streams by unlined earthen ditches reaches the land for which it is diverted. Another large part of the water is lost by evaporation and percolation in being applied to the land, and still more is lost by wasteful use. It is safe to say that not more than one-third of the water diverted from streams serves a useful purpose on the lands for which it is diverted. These losses represent the possibility of future extension. During the past two seasons a special study has been made of the means of preventing them. Where the crops grown justify the expense and climatic conditions permit, most of the transportation losses are stopped by lining the ditches with cement concrete or plaster or by carrying the water in pipes, but this is too expensive for most sections, and what is needed is some effective but cheap means of preventing such losses. In California experiments were made with clay puddle and with heavy crude oil. The oil lining proved to be more than half as effective as cement concrete and cost only one-sixth as much. In Oregon experiments were made in mixing lime and manure with the sand through which the canals passed, with good effect, but the practice which yielded the best results in Oregon was the use of a chain lying across the canal on the bottom and dragged along the canal, destroying vegetation and puddling the bottom so as to stop a large part of the seepage losses.

Experiments in California have shown that probably one-half of the losses by evaporation can be stopped by applying the water in such a way that the top soil does not become wet, wherever this is possible, and by cultivation as soon as possible after irrigation.

Other experiments show the necessity for the adaptation of methods to soils. A small stream run onto an open soil may sink away beyond the reach of plant roots, while a large stream applied to a heavy clay may run over the surface and waste at the lower end of the field without going deep enough to do any good. While this is appreciated, in a general way, the studies of the Office on percolation have shown it up much more clearly, and are bringing home to water users the necessity for studying their soil and subsoil and varying their methods of irrigation to fit their conditions.

These investigations all deal with how losses can be lessened or stopped. In the studies which have been made of irrigation laws and institutions the object has been to find out how economy may be brought about. In most of the arid States the water-right holder is entitled to continue to divert as much water as he has been using, except that there must be no absolute waste. Under such laws there is no incentive to economize. The more water is used at present the larger will the right be in the future when it is needed more. Many canal companies agree to furnish sufficient water for definitely defined tracts of land. The farmer uses all he can every year in order that he may always have enough. If he economizes, the saving goes to the company and not to himself; he can not sell it nor dispose of it to anyone else, and he is apt to feel that the more he uses the more he gets for his money, even if he injures his land by taking too much. On the other hand, where farmers pay according to the amount of water they receive or are allowed to use the water they receive on any lands they choose and on as large or as small an area as they please, they reap the benefit of their economy, and therefore use only what they think is necessary. In the Imperial Valley, California, for instance, where the supply of water is unlimited and there is a continuous growing season, so that there would be a tendency to use large quantities of water, but where the farmers pay according to the quantity of water they receive, the quantity used is as low as anywhere else in the United States.

While economy of water is of great importance from the public standpoint, since on it depends future extension of the irrigated area, and to the individual, since it affects the cost of water, other questions relating to structures, measurement of water, when to apply water to crops, implements for making ditches and embankments, etc., are of great consequence to irrigators.

In the early stages of irrigation development in almost every section water is distributed from earthen ditches in a sort of rough-and-ready style. As time passes practice is constantly improved. In furrow irrigation at first the ditch banks are cut at the head of each furrow or every few furrows, but this gives an uneven crop. Later tubes are placed in the ditch banks to secure a more permanent ditch and a more uneven distribution of water. The next step is to wooden flumes and then to cement flumes, each step in this advance bringing inquiries as to efficiency, methods of construction, and cost. Structures adapted to other methods of applying water are equally important.

As pointed out before, one of the great factors in securing an economical use of water is the basing of charges on the quantity used. This necessitates the measurement of water to consumers, and one of the most difficult problems in canal management is the development

of a practicable system of measurement. The Office has been working on this by collecting information as to the systems in use and by experimenting with measuring devices, in the hope of devising a more satisfactory system.

Both the time and manner of applying water have a great influence upon the crop, as well as upon the quantity of water used. Experimenting along this line has only begun, but our experiments made in cooperation with western experiment stations show great possibilities of improvement in yield and quality of crops by applying water at the proper stages of plant growth.

#### DRAINAGE INVESTIGATIONS.

Notwithstanding the rapid expansion and development of the work of Drainage Investigations during the past year, the office and field force available were inadequate to meet the demands for information, advice, and assistance in the drainage of agricultural lands which came in from all sections of the country, and for this reason many such requests could not be granted.

The work was conducted along the following lines, now fairly well established:

(1) The examination and comparison of past and current drainage practice as developed under varying conditions in different parts of our own and foreign countries. In this study special attention is given to ascertaining the success or failure of methods employed in the attempted solution of the problems arising, and also the relative value of the various systems used in localities where drainage is an important factor in agricultural development.

This information is systematically arranged and issued at intervals in bulletin form, thus placing within the reach of all interested in drainage enterprises not only the latest and most reliable data upon which to base their plans of operation, but an epitome of the best practices obtaining at home and abroad, by which they may be guided in their choice of methods.

As this knowledge is supplemented continually by additional research and the results of practical experiments carried on from time to time, it will come to form ultimately a valuable compendium upon the subject, which will be welcomed by the many who are seeking reliable and detailed information in regard to the various phases of drainage work.

(2) Assisting farmers, communities, and States in the initiation and direction of drainage improvements. It has been the unfortunate experience of most localities requiring drainage to have a large portion of the first attempts at securing needed improvements result in total or partial failure. Such fruitless efforts not only entail

financial loss and delay, but tend greatly to discourage and render more difficult the prosecution of other meritorious enterprises. It is with the hope of preventing the repetition of these costly mistakes and of encouraging and promoting correct practices that this Office aids in the inauguration of drainage projects. Assistance is given most fully in those States and localities where drainage is a new feature, there being no previous similar local work to serve as a guide and example. The most common errors in the preparation of drainage plans arise from a lack of the technical knowledge requisite to develop good engineering designs and from a want of realization of the magnitude and extent of work necessary to the success of the undertaking. In these matters this Department is in position, by reason of the experience and standing of its staff, to give advice which carries weight sufficient to settle local differences of opinion and thus to secure the cooperation of all the parties interested.

(3) Examinations and experiments relating to technical problems in land drainage, regarding which there is at present a lack of complete information. These include investigations to determine the drainage coefficient of various types of agricultural lands, the relation of flood run-off to different climates and kinds of topography, systems for draining muck lands which border on peat formation, the movement and behavior of soil water in irrigated land, the laws of the erosion and of the sedimentation of ditches, tests of the best methods of making, handling, and using cement drain tile, and similar questions. The experiments on the efficiency of the use of drain tile under new and extreme conditions, which the Office has been conducting, are an illustration of this kind of experimental work. These tests have been made in ground which freezes to a depth of 6 feet or more in the far North, in the sticky and impervious gumbo soils of the southern Mississippi Delta region, and in the exceedingly fine volcanic ash deposits of the irrigated Rocky Mountain region.

The operations of the Drainage Investigations have included work during the past year in about two-thirds of the States of the Union. The more important localities and the nature of the operations in each are briefly described below (see fig. 1).

#### KANKAKEE VALLEY PROJECT.

The survey of the Kankakee Valley project in Indiana was completed and a report embodying the results of three years' investigation was prepared and transmitted to the local authorities. Nearly half a million acres in this valley was once a marshy plain. During the last twenty years numerous small projects have been successfully completed for the drainage of separate portions of the upper valley and along the outer margins by means of straightening, cleaning, and

deepening the channels of the streams in different places. In this way large areas have been rendered available for profitable agriculture. At the time this Office took up the work local differences of opinion had become so marked that it seemed impossible for the various interests to reach an agreement as to the best method for continuing the improvement through the main lower part of the valley.

As a result of the careful surveys and studies by our engineers a comprehensive plan was prepared in this Office for increasing the carrying capacity of the lower portion of the river channel by shortening its length from 72 to 42 miles. This is accomplished by cutting off eighty-four bends of the present stream by cuts varying from 150 to 5,500 feet in length. The excavation of this channel will require



FIG. 1.—Map showing localities where drainage work has been carried on.

the removal of nearly 10,000,000 cubic yards of earth and will cost approximately \$1,000,000. Probably 500,000 acres of land lying in six counties in Indiana and one in Illinois will be directly benefited. The increase in value of these lands due to their reclamation can not be accurately estimated, although similar land in Indiana has risen from an original value of \$5 per acre to a price approximating \$100 per acre.

A report is being prepared for publication describing the general features of this project, and especially dealing with the methods which were worked out for the solution of problems having a general interest and applicable elsewhere.

## NORTH DAKOTA PROJECT.

Surveys of the low land subject to injury by overflow lying along the Red River of the North, in North Dakota, were concluded in Pembina County, which completed a system previously begun, embracing also Cass, Traill, Grand Forks, and Walsh counties. The total area surveyed was about 3,000 square miles, for the drainage of which plans and estimates were prepared under a cooperative agreement between the counties interested, the State engineer's office of North Dakota, and this Office.

A report on this project which has been printed <sup>a</sup> and submitted to the respective county authorities contains a description of the region, including its peculiar topography, climatic conditions, natural drainage, etc. The distinctive feature of this region is the large area of rolling country which contributes its run-off to the lower extremely flat valley floor that is but poorly equipped with sluggish and tortuous natural streams. The report includes maps of the whole territory surveyed, with plans and specifications for ditches located chiefly along section lines about one mile apart, and of a size sufficient to protect the land from the occasional overflows which now cause damages, sometimes to the extent of millions of dollars in a single season. It also contains estimates of cost, and especially discusses the fundamental relations of all the factors affecting the drainage problem in such a way that the results and principles established here may be applied to conditions of similar character elsewhere.

## NEOSHO VALLEY, KANSAS.

The field work on this project was completed and plans prepared and submitted to the landowners of the valley for improving the Neosho River in southeastern Kansas.<sup>b</sup> The watershed drained by this stream embraces 5,090 square miles, and the plans recommended for adoption provide for the protection of 161,000 acres of overflowed land at an average cost of about \$10 per acre. It is generally believed that the loss and damage from overflow in the year 1904 amounted to more than this estimated cost. The report now in press discusses fully the engineering problems involved, and the maps accompanying it show the elevation of the overflowed lands and the location and details of the proposed improvements.

The question of methods best adapted to secure adequate protection from injury by floods along the interior rivers of this country has become one of vast importance in recent years, owing to the high values acquired by our agricultural lands and the resulting tendency to make use of every portion of available area. The resources of this

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<sup>a</sup> U. S. Dept. Agr., Office of Experiment Stations Bul. 189.

<sup>b</sup> U. S. Dept. Agr., Office of Experiment Stations Bul. 198.

Office have been taxed by the numerous requests for information and advice on this subject of flood protection. While relating especially to the Neosho Valley, the report deals broadly with the whole question, explaining in an elementary way the general fundamental principles involved and the methods that must be followed in the solution of similar problems elsewhere.

#### THE EVERGLADES, FLORIDA.

During the winter of 1906-7 a preliminary survey was made of a part of the Everglades of Florida, an area of swamp land covering some 5,000 square miles. A line of levels was run from Fort Myers on the Gulf coast across the glades south of Lake Okeechobee to the Atlantic coast, connecting on the way with the surface of Lake Okeechobee. This survey was made in the face of great physical difficulties, since it was necessary for the men engaged in it to carry all their instruments, camp equipment, and supplies for a distance approximating nearly 50 miles through soft muck with the aid of canoes for only part of the way. This was the first time that a survey had ever been carried across the region, although there have been numerous previous attempts. The results obtained encourage the hope that the further investigations which are being made will prove the practicability of reclaiming profitably for agricultural use a large portion of this land which is now too wet to be successfully cultivated and is hence practically worthless. In continuation of the work on this project during the current year a careful examination will be made to determine the most feasible location for an artificial drainage channel from Lake Okeechobee southeast to the Atlantic Ocean.

#### LOWER MISSISSIPPI VALLEY.

Much attention has been given to the possibilities of drainage in the Delta region of the lower Mississippi Valley, where a very active interest in this question has recently developed. In Arkansas, Louisiana, Mississippi, and Missouri there is a rapidly growing agitation of the matter. The completeness of the levee system is now rendering safe the expenditure of large sums for the improvement of the low, flat lands formerly subject to overflow by the Mississippi floods. This Office has made preliminary examinations of considerable portions of this region and has, so far as means were available, assisted in the organization and plans for actual drainage construction for definite limited areas. Preparatory surveys have been completed, drainage plans and specifications determined upon, and reports of the same made to the proper local authorities of the following drainage districts: In Louisiana, Collinston, in Morehouse Parish; in Mississippi, Black Bayou in Washington County, Coahoma County

District No. 1, By Wy and Trim Cane Creek project in Oktibbeha County; in Arkansas, Lee County Drainage District No. 2.

Surveys have been made and the reports are nearing completion on the following projects: In Louisiana, Tallulah in Madison Parish; in Mississippi, Bolivar County, McKinney Lake project in Tunica County, the Coldwater River project in De Soto, Panola, Quitman, and Tunica counties; in Arkansas, Lonoke project in Lonoke County, Camp Bayou project in Ashley County.

#### TIDE LAND RECLAMATION.

The problem of the reclamation of the swamp tide lands along the Atlantic coast has been frequently urged upon this Office and has received special attention during the last year. Careful examinations have been made in various localities, advice has been given, plans have been prepared, and publications have been issued devoted to this phase of drainage.<sup>a</sup>

#### DRAINAGE IN THE IRRIGATED REGION.

During the last year this Office has continued experiments and investigations in connection with the drainage of irrigated lands in various portions of the arid West. In Washington a survey was made and preliminary plans were prepared with an estimate of the cost of reclaiming 20,000 acres of overflowed land in the Colville Valley. Investigations of lands injured by seepage and alkali in the Moxee Valley were continued, and plans prepared for their reclamation. In Oregon experiments were begun to determine the best system of drainage for use at Albany and other similar locations in the Willamette Valley, where both irrigation and drainage may prove necessary for the most successful crop production. In California investigations were continued to determine the feasibility of drainage around Fresno, where water has to be removed by pumping, and to decide upon the best system for collecting the water and the most efficient type of machinery for pumping. In Utah experiments were continued to determine the possibility and profitability of draining and reclaiming areas of land once under successful cultivation by irrigation and subsequently injured or ruined by the accumulation of water and alkali. Experiments are in progress to determine which of the various available materials are the most practicable for use in constructing underdrains suitable for installation in the diversity of soils found throughout the State. In Wyoming surveys were made and plans were prepared for drainage systems in the Grey Bull Valley on irrigated land in which the seepage

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<sup>a</sup> U. S. Dept. Agr., Office of Experiment Stations Rpt. 1906, p. 373; Circ. 76.



water and alkali have been so injurious as to suggest its abandonment. In Colorado surveys and drainage plans were made for portions of the San Luis Valley, where the loss of large tracts once under profitable irrigated cultivation was imminent from the same cause.

From all sections of the irrigated States the Office has received urgent requests for advice and assistance, which in numerous cases could not be granted. Experiments along this line have been very successful and encouraging. Where the plans prepared by this Office have been put into execution the results secured have often far exceeded the most sanguine expectations of the interested landholders. The problem of the proper drainage of irrigated lands is one of vital importance in western agriculture and one whose magnitude is not yet fully realized. Although a troublesome and intricate matter, it is one which if undertaken in time can usually be solved safely and satisfactorily. Our western country in this respect is only repeating the earlier experience of Egypt and India. Speaking of the widespread importance of this question, Sir Hanbury Brown, in his well-known work, *Irrigation—Its Principles and Practices as a Branch of Engineering*, says:

Most countries, in short, which have occupied themselves with irrigation have learned sooner or later that drainage also must receive its due share of attention.

The carefully conducted investigations of this Office have shown the entire feasibility in most cases of preventing the ruin of irrigated land by the accumulation of excess seepage water and alkali. Furthermore, it has been shown that, in general, such land can be restored to fertility even after it has reached such a condition that it can support no useful crop. A comprehensive report is being prepared on this subject which will describe the investigations that have been carried on and their results, and will give detailed directions as to the best methods for use in draining irrigated land under the various conditions met in actual practice.

#### PUBLICATIONS.

During the year ended June 30, 1907, irrigation and drainage publications issued included 7 technical bulletins, 3 *Farmers' Bulletins*, and 1 circular, besides a few special articles. Four other technical bulletins were also prepared but not actually printed during the year. The subjects treated in the publications are: Technical bulletins—The State engineer and his relation to irrigation; Irrigation in Montana; Evaporation losses in irrigation and water requirements of crops; Small reservoirs in Wyoming, Montana, and South Dakota; Mechanical tests of pumping plants in California; Mechanical tests of pumps and pumping plants used for irrigation and drainage in

Louisiana in 1905; Irrigation in the Yakima Valley, Washington; Report on the drainage of the eastern parts of Cass, Traill, Grand Forks, Walsh, and Pembina counties, North Dakota; Irrigation in Northern Italy, part 2; Tests of internal combustion engines on alcohol fuel; and the Irrigation and drainage laws of Italy; Farmers' Bulletins—Practical information for beginners in irrigation, Modern conveniences for the farm home, and the Use of alcohol and gasoline in farm engines; circular—Investigations of irrigation practice in Oregon.

### PROMOTION OF AGRICULTURAL EDUCATION.

There have been many evidences during the year of a growing tendency to give greater prominence to agriculture in our scheme of education. The President has given it hearty indorsement in several notable addresses and in his annual message to Congress; national legislation to extend the teaching of agriculture along several lines is pending; one State legislature has provided for it in its public schools; our youngest State has made definite constitutional provision for it; long-established universities and colleges have accorded it a place either in their undergraduate courses or among subjects suitable for graduate research, and the National Education Association has made definite arrangements for the organization of a department of rural agricultural education which will have a full programme at the next convention of the association.

There have been correspondingly large demands upon the Office of Experiment Stations for publications, aid in preparing courses of study, addresses at important meetings of educators, and other assistance. The Expert in Agricultural Education has devoted his whole time and that of his clerical assistants to this work and to editorial work on the department of agricultural education in the Experiment Station Record and on educational circulars and bulletins. During the year he has visited the agricultural colleges and some of the normal schools in fourteen States west of the Mississippi, given addresses at three large and many smaller meetings of teachers and farmers, and prepared a number of articles for publication, including a Yearbook article on "Training courses for teachers of agriculture" and the annual summary of the progress of agricultural education, which is included in this report (p. 237). The Office has also aided in the training of teachers of elementary agriculture at teachers' institutes and summer schools.

The Director of this Office has accepted the invitation of the committee on graduate study of the Association of American Agricultural Colleges and Experiment Stations to act as dean of the Graduate School of Agriculture during its third session, which will be held at Ithaca and Geneva, N. Y., in July, 1908. During the year he has

aided the committee of the association on instruction in agriculture in its important work of formulating courses in agriculture and has spoken at State teachers' associations and a number of other important conventions.

The land-grant colleges united in celebrating the fiftieth anniversary of the opening of the first State agricultural college. These institutions enrolled more students of agriculture than ever before, enjoyed more liberal State appropriations, and devoted larger funds to the construction of buildings designed especially to meet the needs of instructors, investigators, and students of agriculture. Forty-two per cent of these institutions and 35 per cent of the State normal schools are now aiding in the movement to train teachers of agriculture for secondary and primary schools.

Buildings were started, and in some cases completed, for the agricultural schools in Georgia, several of which planned to open their doors in January, 1908. New agricultural high schools were started at Menominee, Mich., and Winneconne, Wis. The agricultural high schools in Alabama were given more liberal State funds, and nearly all of the agricultural high schools mentioned in previous reports continued their work in a satisfactory and successful way. Experiments in teaching agriculture in public high schools at Waterford, Pa.; Calvert, Md.; Panora, Iowa, and other places are furnishing valuable data concerning the character and amount of work suitable to be undertaken in such schools.

Among the elementary schools of agriculture the Baron de Hirsch School at Woodbine, N. J., affords a good example of the training in English, mathematics, civics, and the science and practice of agriculture which it is possible to give Russian-Jewish immigrants within two or three years after their arrival in America, in institutions where an efficient faculty and a good equipment are provided.

The legislature of Texas passed a law requiring that agriculture be taught in all schools of the State having an enrollment of less than five hundred, and the constitutional convention of Oklahoma inserted in the constitution a provision for the teaching of agriculture and home economics in all of its schools. The literature emanating from State agricultural colleges, and especially from those institutions which have organized extension departments, included much of a helpful nature relating to instruction in elementary agriculture.

This Office is endeavoring to keep in touch with all phases of the forward movement in agricultural education, and in this effort it is having the hearty cooperation not only of other bureaus of this Department but also of the State agricultural colleges and other institutions engaged in teaching agriculture. It is attempting to collect information which will be helpful to these institutions, and to disseminate this information through publications, correspondence, and

public addresses. Thus it hopes to continue and gradually broaden its work as a clearing house for agricultural education in the United States.

### FARMERS' INSTITUTES.

The Office has continued its efforts to promote the general interests of farmers' institutes in the United States in cooperation with State directors and local managers of institutes. It has also aided the agricultural colleges, experiment stations, and other organizations in the more general diffusion of agricultural knowledge among the rural population under various forms of so-called "extension work." This work has been, as heretofore, under the immediate direction of the Farmers' Institute Specialist, Prof. John Hamilton, whose detailed report will be found on page 307.

Farmers' institutes have been organized in all of the States and Territories, except Alaska. During the past year reports have been received from the directors of farmers' institutes in 44 States and Territories. These show that there has been a steady increase in attendance at the institutes and a considerable increase in the amount of money appropriated for maintaining the institutes. From the data furnished by the 44 reports it is found that the total attendance at all of the institutes held in the States represented in 1907 was about 1,597,000, which represents an increase over the attendance in these States and Territories in 1906 of about 298,000. The total number of institutes held in 1907 was 3,927, as against 3,521 in 1906. The aggregate of appropriations for institute work in the States reporting for 1907 was \$284,450, an increase of nearly \$15,000 over the appropriations for the previous year.

The character of instruction given in the institutes is every year becoming more varied and comprehensive and its grade is constantly being raised. To meet this demand an increasing number of States are holding normal institutes for the instruction of their lecture force, and State directors are obliged to select their lecturers with greater care than formerly.

Efforts have been continued to organize and develop movable schools of agriculture, which are intended to supplement farmers' institutes by short courses of instruction in special subjects at the agricultural colleges and in different agricultural districts. To aid this movement by showing definitely the character of courses of instruction which might be given on this plan the Office has arranged with agricultural experts for the preparation of a number of such courses. Two of these have already been published—a course in cheese making, by Dr. L. L. Van Slyke, of the New York Experiment Station, and a course in fruit growing, by Prof. S. B. Green, professor of horticulture in the Minnesota Agricultural College.

In cooperation with the standing committee on extension work of the Association of American Agricultural Colleges and Experiment Stations, the Office has made an extended study of the agencies outside of farmers' institutes which have been or may be utilized in diffusing agricultural knowledge among the rural population at large, and the results have been embodied in reports of the committee and in circulars of the Office. In connection with this work a study has been made of the progress of agricultural education in foreign countries, as well as in the United States.

The Office has continued to work in close cooperation with the American Association of Farmers' Institute Workers, the twelfth annual convention of which was held at Washington, D. C., October 23-24, 1907, and was attended by 131 delegates, representing 25 States and Territories, and 4 Provinces of Canada. The proceedings of this convention have been published as a bulletin of the Office (see p. 310).

### PUBLICATIONS.

While the publications of the Office have increased materially during the past year in number, the volume (total number of pages) is somewhat less as compared with the output of the previous year. This has been mainly a result of an earnest and systematic effort to restrict publication to the lowest limits consistent with the efficient performance of the functions of the Office, and notwithstanding the fact that the recent progress of agricultural education and research throughout the world, as well as of the special investigations of the Office, has been so rapid as to make it increasingly difficult to present an adequate record of it with the facilities available in the Office and under the present printing limitations.

During the past fiscal year the Office published 85 documents, not including revised reprints, separates, etc., aggregating 4,946 pages. These documents include 13 numbers of Experiment Station Record, 21 technical bulletins, 1 bulletin and an annual report of the Alaska Experiment Station, 1 bulletin (English and Spanish editions), 1 circular (English and Spanish editions), and an annual report of the Porto Rico Experiment Station, 2 reports, 11 Farmers' Bulletins (including 6 numbers of the subseries Experiment Station Work), 7 circulars, 3 articles for the Yearbook of the Department, 9 lists of experiment station publications, and various miscellaneous documents. Two other numbers of the Experiment Station Record, 6 technical bulletins, 1 annual report, an annual report of the Hawaii Station, 2 Farmers' Bulletins, 1 circular, and several miscellaneous documents containing about 1,300 pages, were prepared and submitted for publication before the close of the fiscal year. The policy of reprinting a limited number of separates of individual articles contained in larger reports was continued with satisfactory results.

Twenty-one such separates, aggregating 563 pages, were reprinted in editions of varying size to meet the actual demands for the articles.

Several of the earlier technical and farmers' bulletins of the Office were exhausted during the year and were reprinted, in many cases with complete revision or more or less important additions and corrections.

The publications of the Office during the past year were, as heretofore, of five main classes: (1) Annual reports, including the administrative report of the Director and the larger annual report of the Office. (2) Experiment Station Record, which gives a technical review of the current literature of agricultural investigation throughout the world, and Experiment Station Work, which is published periodically in the Farmers' Bulletin series of the Department and gives a popular summary of some of the more salient practical results of the work of the experiment stations. (3) Publications relating to the food and nutrition of man, consisting of technical and popular bulletins, circulars, etc., reporting or based upon the results of nutrition investigations conducted under the auspices of the Office. (4) Publications relating to irrigation and drainage, which include reports, technical and popular bulletins, circulars, etc., giving the results of the irrigation and drainage investigations of the Office. (5) Educational and other publications, including those relating to agricultural education in general, including farmers' institutes, proceedings of the Association of American Agricultural Colleges and Experiment Stations, and of the Association of Farmers' Institute Workers and similar publications, and the card index of experiment station literature, besides miscellaneous documents of various kinds.

The report of the Chief of the Division of Publications for 1907 shows that about 2,400,000 copies of the publications of the Office, including both new publications and reprints, were issued during the past fiscal year, of which 2,075,000 were Farmers' Bulletins.

### INCOME.

The income of the Office during the past fiscal year, derived wholly from appropriations by Congress, was as follows:

For the general business of the Office.....	\$54,660
For the Alaska Experiment stations.....	18,000
For the Hawaii Experiment Station.....	20,000
For the Porto Rico Experiment Station.....	15,000
For investigations on agricultural schools and farmers' institutes.....	5,000
For nutrition investigations.....	20,000
For irrigation and drainage investigations.....	122,200
Total .....	254,860

THE END

# WORK AND EXPENDITURES OF THE AGRICULTURAL EXPERIMENT STATIONS.

By E. W. ALLEN.

## REVIEW OF THE YEAR.

The year 1907 marked the twentieth anniversary of the experiment station system in the United States as a national institution. It was also the twenty-fifth anniversary of four of the stations established by the States—Massachusetts, New York, Ohio, and Tennessee. Only seven years ago the quarter centennial of the first American station was celebrated in Connecticut. These facts point to the youthfulness of these institutions, and thus emphasize the remarkable development of their work and influence.

The anniversary of the New York State Station was observed at Geneva, on August 29, with field-day exercises which were attended by over 3,000 persons. Addresses were delivered which called popular attention to the substantial nature of agricultural progress during the last generation, and the epoch-making policy which led to the establishment of experiment stations as a basis for agricultural advancement. It was recalled that during the seventies the work of the farm had become unexpectedly complex, and hindrances unknown to the earlier husbandry had increased the hazards attending farm practice. Many sections were suffering seriously from an exhaustion of the soil; new and unknown insects appeared in great numbers; noxious weeds multiplied with extreme rapidity, and unfamiliar diseases worked havoc in flocks and herds. The futility of individual experiment and the inadequacy of existing agencies in combating such conditions were in due time appreciated, and led to a demand for the State to cope with the problem. The result was the provision by the New York legislature, in 1880, for an agricultural experiment station as a State institution, for the purpose of "promoting agriculture in its various branches by scientific investigation and experiments," and its actual commencement of work in the spring of 1882.

The period represented by the life of the station was aptly characterized as one of transition from the sway of tradition and superstition in agriculture to the domain of exact knowledge. The newly organized station faced a constituency which, while hopeful, was none the less to a degree apprehensive that the new effort might be fanciful and visionary in its origin, and would be impractical in its results;



while to-day "the agricultural scientist feels that his right to live and labor is recognized." From a staff of 4, representing the basal departments of agriculture, chemistry, and horticulture, the number of scientific and clerical workers at that station has increased to 31, and 15 laboratory and other buildings are in use, with 5 more to be added in the near future. To-day the annual income of the station aggregates over \$90,000, only \$2,200 of which is obtained from Federal sources, indicating the liberality of the State in its maintenance.

This liberality, which is illustrated by the State of New York, is becoming more widespread each year. The past year furnishes increasing evidence of this tendency, which reflects in unmistakable terms the increasing appreciation in which the stations and their work are being held. The Tennessee legislature appropriated \$40,000 for a permanent substation in western Tennessee, and \$10,000 for cooperative experiments in agriculture. In Washington the substation at Puyallup, in the western part of the State, was revived with an appropriation of \$20,000 for the biennium, and in North Dakota the legislature established twelve demonstration farms. Kansas gave \$57,000 for the branch station at Fort Hays, and Montana increased the appropriation to the station 50 per cent and added \$80,000 for an agricultural building. The Indiana Station received \$100,000 for the erection and equipment of a building to be used exclusively for station purposes; and in Florida an office and laboratory building for the use of the station, to cost \$40,000, was authorized.

In Delaware the State issued bonds to purchase a farm for the use of the college and station jointly, and in California the new farm given by the State was put in condition for work and buildings are being erected. A large agricultural building with special facilities for the station work was completed in Virginia, and another in Vermont, an unusually well-equipped botanical building in Massachusetts, and in Alabama \$75,000 was set aside for an agricultural building to be erected soon. The new group of buildings for the College of Agriculture at Cornell University, in which the station shares liberally, was completed and occupied during the year; a group of agricultural buildings at Pennsylvania State College, which has cost over \$300,000, was dedicated during the fall of 1907, and good progress was made in the erection of the new agricultural building at the Iowa State College for which \$350,000 has been set aside.

A notable feature of these new buildings which are being put up for the colleges of agriculture and the experiment stations is their substantial character, many of them being of fireproof construction, their ample proportions, and the special provisions made for the different kinds of work in the construction and equipment. Many of these buildings at the large universities now compare with those for

any other department of the institution, and thus stand as an evidence of the present position and prominence of the agricultural work.

In Pennsylvania an institute of animal nutrition was established at the close of the year, Dr. H. P. Armsby, the former director of the station, assuming charge of the new institute. This will be coordinate with the experiment station, and will be devoted to researches upon the principles of animal nutrition, making use for that purpose of the respiration calorimeter which was erected at the station several years ago. The institute will be conducted in cooperation with the United States Department of Agriculture, and exceptional opportunity will thus be afforded for fundamental investigations upon the feeding of farm animals and the economy of animal nutrition.

In North Carolina the experimental work of the State department of agriculture and the Federal station was separated with the formation of two stations, one connected with the State department of agriculture and the other with the agricultural college. This change was brought about by legislative action providing for the transfer of the control of the station from the State department of agriculture, where it had been placed a few years previously, to a separate board to be appointed by the governor.

Increasing provision has been made to economize the time of station men. This has been brought about in part by reducing the amount of teaching, farmers' institute, and similar work required of them, and in part by concentrating the teaching so that it will present less interruption and leave more continuous time for the station work. In other cases the inspection and routine work have been better organized so that they will not so seriously interfere with the investigations.

There has been an increasing amount of demonstration work, but this has been provided for almost exclusively by special State appropriations. The value of this work to the community in presenting the results of the station's findings and in working out minor details for the different localities is beyond question, but the Office has consistently maintained that such forms of activity should not constitute a feature of the work under the Hatch fund, but should be supported mainly by special funds. Demonstration farms and branch stations are now maintained in California, Colorado, Idaho, Kansas, Michigan, Minnesota, Mississippi, Montana, Nebraska, Nevada, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, and Washington; and in a large number of other States centers are maintained where cooperative experiments are conducted in the interest of local problems and in the demonstration of better methods.

The tendency of the stations to study the problems of the State as a whole, rather than merely those in the immediate vicinity of its

location, is developing noticeably. This is leading the stations to go out into different parts of the State where special problems of soil, plant diseases, insect outbreaks, etc., are to be found, or where special branches of agriculture are practiced. Such work has broadened the scope of the station work, and made it a more efficient and influential institution throughout the State.

### PROGRESS IN FOREIGN COUNTRIES.

There has been unusual activity of late in the organization of experiment stations and similar agencies in foreign countries. In India plans have been matured by the government for a series of agricultural colleges and experiment stations in eight provinces, together with a large number of experimental and demonstration farms. The Agricultural Research Institute at Pusa, established with an endowment of \$150,000 given by Mr. Henry Phipps, of Pittsburg, Pa., has just been completed and is opening its laboratories. This will be the capstone of the system for agricultural experimentation in India. An agricultural journal has been provided as an organ for this institute, through which its more popular work will be published.

Two experiment stations have been established in Ceylon, one in the wet and the other in the sparsely inhabited dry zone; and the Royal Botanic Gardens of Ceylon have been greatly developed in respect to their distinctly agricultural work. The Madras department of agriculture has arranged to start two new stations, one at Attur, in the Chingleput district, and the other at Nandyal, in the Kurnsol district. Both stations will be devoted quite largely to the study of cotton, the Attur station especially to perennial and exotic cottons under irrigation. The Mexican Government has located an experiment station at Xopala, in the State of Puebla, for general agriculture, and a botanical station has been opened at Chiapas, principally for experiments with rubber and some work in hybridizing coffee.

The Japanese Government has established an experiment station and model farm at Suwon, Korea, at an expense of \$85,000. The object of the station will be to bring about better geographic distribution of the principal crops, to introduce and breed new crops and improved varieties, to study methods of irrigation and of fertilizing, and in general to promote better farm practice. An experiment station for cereal culture has been opened at Rieti, Italy, with the object of increasing the production of wheat and other cereals. A new demonstration farm for irrigation work has been established in Victoria; and three tobacco experiment stations in South Africa for experiments in selection, breeding, and curing tobacco.

The Chinese Government has turned over the Loshan Garden, near Peking, to be used for field experiments in agriculture. The tract

contains about 166 acres, and was set aside at the instance of the native board of commerce at Peking. This board was authorized in 1905 to take measures for the encouragement of agriculture, but up to the present time little has been done except field experiments on a number of farms. An experiment station for vegetable physiology and pathology has been established at Grignon, France, and in the French Kongo an order has been issued for the establishment of a trial garden at Agonenzork to investigate the culture of cacao and rubber trees. The station on the island of Guam, which was established under the local government in 1905, has begun the publication of bulletins of information.

The German Government has provided an institute of milling research in Berlin, at an expenditure of \$150,000 besides an annual grant for maintenance. The institute includes an experimental granary, wheat and rye flour mills, and a bakery. It will be devoted to scientific and practical studies on grain during storage, milling, and baking, including both home-grown and imported grains. A system of fifteen apiculture stations has been organized at Wurttemberg for the purpose of studying the amounts of honey gathered by different swarms of bees, and other matters.

#### PERSONNEL OF THE STATIONS.

The year has witnessed an unusual number of changes in the personnel of the stations, and especially in the directorships. Since the last report there have been changes in the directors of fourteen of the stations. This has been due in part to change of organization and adjustment to new conditions growing out of the Adams Act, in part by the retirement of the former incumbents from active station work, and in part to considerations of a purely local character.

In Wisconsin, Prof. W. A. Henry, who had been director of the station since 1883, resigned his office on account of ill health at the close of the year, and in Minnesota Dean Liggett, who had been director of the station for ten years, withdrew from active service for a similar reason. In Georgia, Director R. J. Redding, who had been at the head of the station since its organization, retired from active service in the fall of 1906. In Massachusetts, Dr. C. A. Goessmann, one of the pioneers of agricultural investigation in this country and for many years the director of the station, relinquished his active connection with the institution on account of advancing years.

In New Hampshire and Washington the offices of president and director were separated after being combined for many years, directors being appointed as separate officers in each instance. This action is in accordance with the policy consistently urged by this Office, that the station business has grown to such importance that it needs and

should have the full time of an executive officer not burdened with the administration of college affairs. These offices are now combined in only four institutions—Nevada, New Mexico, North Dakota, and Texas. In eight other stations the office of director is combined with that of dean of the college of agriculture, an arrangement which is open to less objection.

There have been many changes in the members of the station staff, and the search for men to carry on the work of the station under present requirements has continued very active. The year has made it very evident that the most vital question before the experiment stations at the present time is that of human equipment. The man is the starting point in all investigation and the all-controlling factor. Investigation is an individual product, and without a presiding genius at its head generous funds and elaborate equipment become ineffectual. The rapid development of the United States Department of Agriculture has drawn heavily upon the available supply. This is especially noticeable in special lines of work. The food inspection under the national food and drug law has made a great demand for chemists and drawn many directly from the station forces. The cotton boll weevil work in the South and the gipsy and brown-tail moth work in New England have made large inroads on the ranks of entomologists. Special lines of investigation which the Department has undertaken have often called for the services of specialists who were few in number, and who had been developed out of experience as well as fundamental training. As yet the agricultural colleges are not turning out trained men in sufficient numbers to meet the demands.

One of the chief reasons for the present shortage is found in the higher standards which are being established, rather than in the fact that a relatively small number of men are presenting themselves for it. These standards impose additional requirements and qualifications, and thus practically eliminate from consideration many who might formerly have been drafted. In the past it has been possible to carry on certain grades of station work with men who had had little beyond the agricultural college course coupled with a few years of experience. Such men have a very small place at the present time, for their limitations are soon reached and they can not fill satisfactorily the higher positions or carry on advanced lines of investigation. The present need is not merely one for men, but for men of special qualifications and preparation, for men as broadly and thoroughly trained as in any department of research, men who know the methods and the meaning of research. The selection of a station staff, as someone has remarked, calls for the divining rod rather than the dragnet.

The station can be no stronger than its men. Its strength and efficiency and reliability are measured and fixed by the combined ability of its staff. Stimulating conditions, helpful supervision, suitable facilities and equipment count for much, but they are all secondary—"material equipment is subsidiary to the intellectual," and the development of research must logically begin with the preparation of men properly fitted to conduct research that is worthy of the name.

This matter was the subject of the report of the committee on experiment station organization and policy at the last meeting of the Association of American Agricultural Colleges and Experiment Stations, at Lansing, Mich. It was pointed out that the unprecedented demand for men trained in agricultural subjects is resulting in the appointment to important positions of young men practically fresh from graduation and necessarily deficient in their training. This was deprecated as being seriously detrimental to the kind of work now expected of the stations. Such work, it was urged, calls for special preparation following the college course, quite as much as investigation in any field of science.

The committee urged upon appointing bodies the importance of securing men with the widest possible education and training, and upon the institutions—

that they supply the proper conceptions of scholarship, which, under present conditions, the young men can hardly be expected to acquire as undergraduates, and that they make it clear to young men that satisfactory permanent service can come only through the best preparation the world offers. \* \* \* The agricultural colleges are primarily fitting their graduates not for investigators and teachers but for practical work in husbandry. Good as the courses are for this purpose they are only preparatory to the more advanced study needed by the investigator and the teacher. They do not, nor can they perhaps be expected to, in their undergraduate work, furnish the atmosphere best adapted to the scientific spirit and ideal.

When the exigencies of the situation are such that an institution finds itself compelled to advance to responsible position and good salary a man of inadequate preparation, the committee specially recommended—

that the arrangement shall include a definite understanding to the effect that he shall at once enter upon graduate work in the institution in which he is employed, wherever this is at all practicable, and that in any event there shall be definite plans for his temporary relief in the very near future for the purpose of encouraging graduate study in the best universities of the world.

It was argued that every possible advantage and encouragement should be held out to men who enter this work to adequately prepare themselves for it.

Not all of the agricultural colleges are ready to offer graduate work, but many of them can discover among their students the

exceptional man with the latent traits of the investigator, and stimulate and guide him in the direction of his development. The scarcity of men with sufficient scientific equipment has led the stations in a number of instances to turn to the pure science departments of large universities. As the work becomes more technical the lack of strictly agricultural training is often overbalanced by the more thorough training in the sciences. Given this, the outlook toward agriculture will often be acquired sufficiently for the study of its problems, especially under proper guidance.

This shortage of men is no commentary on the agricultural colleges to which we have looked to provide the human equipment of the stations, and no indication that the time was not ripe for the fundamental investigation provided for by the Adams Act. It is rather an illustration of the interdependence of the station and the college, and of the way in which agricultural education and agricultural research develop hand in hand. The colleges could not develop men in advance of the demand. The passage of the Adams Act, with the small initial appropriation which it carried, has had a remarkable effect in stimulating men to prepare themselves more thoroughly for a career in agricultural research. It has opened up new opportunities which did not exist before, and established new standards for men. This must be counted one of its most important results. There are far more men taking advanced work in agricultural science at the present time than ever before.

The present shortage of men is further accentuated by the higher standard which the Adams Act has imparted for all station work. Many stations have attempted to bring a large proportion of the work which they are prosecuting under the Hatch and other funds up to the standard set for the Adams-fund investigations, and this reflex influence has naturally called for a sudden sifting of the material and a more severe test than was formerly applied. The temporary embarrassment in which some of the stations find themselves will be relieved in a short time by an influx of young men "endowed with a love of learning, of scholarly habit, and with integrity of mind and heart, whose ambition is not for notoriety, but for the conquest of truth, and who, with more thought for service than for salary, are anxious to aid in laying broad and deep the foundations of human thought and activity."

It is now realized that all that is required for progress in any other field of inquiry whatever in the way of efficiency of organization, scientific acumen, and severity of method, is required for agricultural investigation, and that more depends upon thorough preparation than on intimate knowledge of the details of farm practice.

**STATION ADMINISTRATION.**

The problems of organization and administration of station affairs become more difficult year by year, as the activities and relations of the stations become more extensive and complicated. This seems inevitable, but it calls attention to the need of adjustment to the new conditions.

At one time a station council headed by a chairman was deemed sufficient to settle and manage the station business, or a college president through whose office the funds could be allotted and certain general business and correspondence conducted. We soon outgrew both of these arrangements, and have come to regard the station as a unit, not merely as an aggregation of separate departments grouped together for the purpose of sharing certain common funds. There are common aims and interests which bind the different departments together, and aside from this the station as a whole has certain outside relationships and responsibilities. These things have emphasized the need for a distinct organization and for a separate administrative officer. Effective organization has been one of the most important factors in developing the American stations and in giving them individuality.

While the desirability of a director and a certain degree of organization has become generally accepted, our conception of the duties of the director's office has not always kept pace with the growth in the station's activities and the responsibilities imposed. Coupled as these duties usually are with other services and responsibilities, it becomes almost inevitable that some things should be left undone which ought to be done in the interest of good administration.

The very diversity of the station work, with funds for research, for more general uses in agricultural experimentation, and often from the State for more popular features, such as local or cooperative trials or demonstrations, imposes unusual duties on the administrative officer. It calls for careful study of the whole agricultural situation and needs with reference to the station work.

The new special fund for research work, although small at present, has added responsibilities and called more imperatively for careful planning. It has required relatively more attention than most of the funds because of the character of work provided for and the need of adjusting it to other activities of the station. It has necessitated more system. And when we add to the more strictly station work, the supervision of various kinds of police work, a variety of farmers' institute and extension work, the securing of new buildings and equipment, and frequently the supervision of the instruction in agriculture, it often occurs that the director's time is so divided



that it is difficult for him to give adequate attention to the really legitimate station business.

Already many of the arguments forcefully used a few years ago against a college president as director are beginning to apply to the heads of some of our stations as their duties and offices are organized. These men are overburdened with a multitude of interests and duties, and this must inevitably be reflected in the details of their administration. They are attempting to do too much and are scattering their energies. Sometimes they are overestimating their capacity to do well a great variety of things, and in other instances conditions are imposed upon them which they are not able to remedy.

The direction of an experiment station is a business. Apart from the general oversight of the experiments and investigations it involves the judicious expenditure of considerable amounts of money, often under special limitations, and the orderly conduct of the affairs of the institution in a variety of directions. It calls not only for broad training and sympathies, but for good administrative ability.

System and regularity are important factors in any scheme of administration. The lack of this adds greatly to the labors and anxieties, and prevents matters running smoothly in the station's internal and external relations. The difficulties might often be simplified by a closer organization of the station and a systematizing of its work.

While the greatest measure of freedom and individual initiative is desirable to the development of strong heads of departments, there are certain matters which pertain to good administration and which are essential to the proper conduct of the station business. The lack of closer organization and familiarity with one another's work hinders the development of the proper esprit de corps, and often prevents the coordination of the work of the different departments.

The planning of the station's campaign and its policy requires increasing thought and study. The interests of different classes of constituents and the need for various grades of work must be considered, but in this the broader and more permanent needs of agriculture should be given full consideration. These need not be subordinated to the immediate queries of the farmers, for the two can often be harmonized and worked out together. The different phases of the work should be so organized as to offer the least possible disturbance and interruption to the working force, and plans must be laid for relieving the station proper of activities which do not strictly belong to it. Some of these still make quite heavy drains on the men's time. One of the most important functions of the director is to husband the resources and energies of his staff and to preserve

an atmosphere congenial to their best work. This is not compatible with irregularity from day to day, frequent interruptions, change of work, indefinite policy, etc.

With so many station men occupying a dual position, and often with still other interests, a shifting of activities from one line of duty to another is a condition to be guarded against, for it brings great loss of efficiency and of interest in the work. Much can be done to minimize the necessity for this by systematizing the teaching, the institute work, and other duties so that these will leave a greater amount of unbroken time. In a number of cases the conditions have been materially improved, and a general principle has been laid down which recognizes the need of continuity of effort and the desirability of a separate staff for the more important departments.

If the stations are to continue to exercise police control to an ever-increasing extent over fertilizers, feeding stuffs, human foods, insecticides, milk-testing apparatus, nursery stock, seeds, etc., the organization of this work on such a basis that it will not interfere with or interrupt the legitimate functions of the station is a matter of much importance. Improperly organized and regulated, it becomes a serious drain on the efficiency of certain departments, which is not compensated for by the revenue it brings in. These matters may well receive more attention than is sometimes given them, for the scope and amount of this service has greatly increased in recent years. It should be adjusted to the other activities of the station and considered in the light of its effect on general efficiency rather than the revenue it brings in.

The aversion to "red tape" has sometimes prevented discrimination between it and system. A certain amount of system and regularity in the business affairs of a station is essential to successful administration. It lightens the burden of the director and simplifies rather than complicates the duties of his office. The larger the institution the greater is its need, for the affairs soon get beyond the ability of one man to carry the details in his head.

While this applies to the supervision of both the work and the business of the station as a whole, its desirability is well illustrated in the expenditure of funds. The director can not shirk responsibility for the proper management of the station funds. Their supervision is one of his important functions. His general policy and knowledge of the needs of the work should guide him in the judicious use of these funds, and his system of purchasing and accounting should be such as to keep him fully informed as to their status and use. However much latitude he may allow in the purchase of materials after general lines of work have been agreed upon, he should at least know about important purchases of apparatus or equipment before the bills come to him

for approval, and have opportunity to consider the wisdom of the purchases. He should also have sufficient data to intelligently classify the expenses among his various funds.

Directors can not all be made in the same mold, and conditions are not alike at all institutions. But there are certain duties of administration which should be recognized in the efficient management of all station work and business. We have outgrown the simple methods which formerly sufficed. We need more formal and better systematized plans. The stations are growing and their relations becoming more and more involved. We must meet this by more effectual organization and administration.

#### WORK UNDER THE ADAMS ACT.

For most of the stations the year 1906-7 was one of unusual activity in organizing and planning the new work of investigation provided for by the Adams Act. The attitude which has been adopted toward this new fund shows the determination to consecrate it unreservedly to a high order of agricultural research, and to use it as a means of turning more of their other funds in that direction. There has been an absence of embarrassing restrictions imposed by the States, and the boards of control have, as a rule, wisely turned over to the station director and staff the making of plans for the expenditure of the fund.

In planning this new work the Office has been in very close advisory relations with the stations throughout the country. The system described in the last report, of having projects outlined by the stations and passed upon by the Office in advance of beginning work, has involved an unusual amount of correspondence and conference with the station authorities, but has worked out very satisfactorily. The position of the Office has been made clear to the stations, and the spirit of the plan has been cordially entered into by all. The stations have shown a readiness to conform not only with the spirit of the act as they saw it, but with the Department's interpretation. The relationship of mutual confidence and cooperation has been most gratifying.

The Office has assisted the stations in the elaboration of their plans, often serving as the arbiter between the director and his men as to the appropriateness of proposed undertakings, and has attempted in each case to arrive at a clear and definite understanding with the station as to the amount and character of work it was proposing to undertake. Without these preliminary arrangements there would surely have been many differences of opinion in detail, which would have been reflected in the accounts and the financial reports of the stations, and would often have caused serious embarrassment to the latter. As it is, misunderstanding of the restrictions surrounding the fund have

affected the expenditures only in minor ways and have made it necessary to disallow only comparatively small items. These items have been removed from the account at the request of the Office and corresponding unexpended balances reported which, under the act, will be deducted mechanically from the following year's payment. Happily, it has not been necessary to withhold certification of any State to the Treasury Department. In spite of the rigid interpretation of the act which the Office has followed, there has been no appeal from its regulations, and all minor differences of opinion have been adjusted by correspondence.

In all three hundred and twenty projects were passed upon and approved by the Office to apply to the fiscal year 1906-7. This is an average of six and two-thirds projects for each State and Territory, which leaves but little over a thousand dollars to a project. The number varies from two to thirteen to a State. The average is brought down by seven States which had only two or three projects, and six others which had only four. Thirty-five States, or three-fourths, had five projects or over, the total number for these States amounting to two hundred and seventy-eight, or seven-eighths of the whole number of projects. The average for these thirty-five is nearly eight projects.

This is far too large a number to be adequately prosecuted with the funds available under the Adams Act. This has been one of the points of contention and, without authority to insist upon it, the Office has strongly urged that the number should be kept small at the outset, and restricted to such lines as could be carried out in a thorough and efficient manner without being crippled for lack of funds. But there has been a commendable ambition on the part of station men to have at least a part of their work classed under the Adams fund. That fund has in a sense been regarded as an honor roll, in that it indicated a high character of investigation.

In many cases projects have been supported only in small part from the Adams fund, and in some cases lines of work classed under that fund have been supported entirely from other funds. This shows the influence which this fund has had in drawing attention to the distinction between different lines of station activity, and its stimulating effect upon research. The tendency to assign too many projects to the new fund is being corrected as a better understanding is gained in regard to the expense and requirements of these researches. In a considerable number of cases projects which were originally assigned to that fund were transferred to other funds at the close of the year. In other cases it was not found practicable to start work under all of the projects, so that the funds were actually confined to a smaller number of undertakings.

### PUBLICATIONS.

The stations have continued to issue a vast amount of literature relating to the results of their investigations. With the organization of agencies for extension work, the development of the farmers' institute work, and other means of reaching the farmer, the bulletins and reports of the stations have been confined more and more strictly to accounts of their work proper.

During the year the stations published 413 circulars and bulletins and 46 annual reports. These publications aggregate 16,917 pages.

The demand for the publications of the stations increases steadily, and the regular editions at several of the stations now amount to thirty to forty thousand copies. Even these are soon exhausted, and the limitations of several of the stations have been about reached. A number have felt obliged to restrict the distribution outside their own States. The stations' publications are so widely described in the agricultural press of the country that wide publicity is given to their work.

The channel through which the reports of the more technical investigations of the stations are to be issued is attracting considerable attention. The amount of investigation of this grade has been very materially increased by the operations of the Adams Act, and it is realized that much of the data obtained will be unsuited to publish in popular bulletins until final and definite conclusions are reached. Fuller accounts are necessary in the case of these researches than in reporting experiments of a simpler character, for these details will be of interest and value to the specialist. The desirability of bringing the accounts of these investigations together in a serial publication has been pointed out, and seems to be regarded with favor by a considerable number of station men. In this way the accounts of the investigations would be available to the men especially interested in them, and could be more readily followed up by men of science in general than if they were scattered through the publications of various stations. Thus far the increased activity of the stations due to the Adams Act has had little if any effect upon their publications. Such work as it has been deemed desirable to report upon has been reported in popular form in the regular series of bulletins. Most of the work will require considerable time before reports of progress or final conclusions will be warranted, but the matter will need serious consideration very soon. There is a widespread feeling that the time has come when a journal relating to agricultural investigation should be provided in this country. The administration and maintenance of such an organ are questions which remain to be worked out.

**STATISTICS OF THE STATIONS.**

Federal funds are used in the maintenance of at least one experiment station in each of the States and Territories, including Alaska, Hawaii, and Porto Rico. In Alabama, Connecticut, Hawaii, Louisiana, Missouri, New Jersey, New York, and North Carolina separate stations are maintained wholly or in part by State funds or by private contributions. There are also quite a large number of substations or branch stations, the number having increased considerably in the past year. Excluding these substations, there are 60 stations in the United States, 55 of which receive appropriations provided for by acts of Congress. The staff of these stations includes 1,098 administrative officers and scientific workers.

The total income of stations maintained under the act of 1887 during 1907 was \$2,334,671.90, of which \$1,056,000 was received from the National Government, and the remainder, \$1,278,671.90 from State governments, individuals, and communities, fees for analyses of fertilizers, sales of farm products, and miscellaneous sources. The amount derived from the States by appropriation was \$770,016.34. In addition to this, the Office of Experiment Stations had an appropriation of \$254,860 for the past fiscal year, including \$18,000 for the Alaska experiment stations, \$20,000 for the Hawaii Experiment Station, \$15,000 for the Porto Rico Experiment Station, \$20,000 for nutrition investigations, \$122,200 for irrigation and drainage investigations, and \$5,000 for farmers' institutes.

**INSPECTION OF THE STATIONS.**

During the year a personal inspection was made of each of the experiment stations receiving Federal funds, at which time the work and the expenditures under the Hatch and Adams acts were examined in detail. The inspection was taken part in by four members of the Office force—the Director (A. C. True), Assistant Director (E. W. Allen), W. H. Beal, and Walter H. Evans.

As was anticipated, considerably more time was required at each station than formerly, owing to the new fund and the number of questions it gives rise to which require attention and discussion. In the case of this fund a separate accounting has been required and the stations have been expected to identify each expenditure with a particular project or line of investigation. This system was not fully in operation the past year, and hence the vouchers often required explanation. In several cases where the explanation has not been satisfactory the charges have been transferred by the station to other funds.

At the close of the year the following circular letter relating to the keeping of the accounts and vouchers for the Adams fund was sent out:

TO THE DIRECTORS OF THE EXPERIMENT STATIONS:

Considerable difficulty has been experienced in the examination of the accounts for this fund the past season from the manner in which the fund has been handled in the voucher system. To facilitate an intelligent examination it is necessary that the Adams-fund account be supported by a separate set of vouchers, plainly indicated by stamp or color. It will not be satisfactory to include items charged to this fund in the general bills of the college, as this gives rise to confusion and materially increases the labor of examination.

As far as possible the Adams-fund vouchers should contain only items charged to that fund. It will usually be possible to have the bills so rendered as to admit of this separation if the orders are kept distinct. In individual cases where this is not practicable and items are included against other station accounts, the items charged to each fund should be plainly indicated by stamp on the face of the bill and the total amount charged to each fund shown on the jacket.

It is requested that the vouchers for this fund show in each case for what particular projects the expenditures were made. Although the expenses are of the same general character as those from other funds, they are restricted to definite investigations and the accounts are examined on that basis. Hence an indication of the project becomes an essential part of all vouchers for that fund.

It is further requested that the men in charge of Adams-fund work certify the vouchers, in each case, as belonging to the projects on which they are working.

Very respectfully, yours,

A. C. TRUE, *Director.*

The examination of the station accounts, both at the time of the personal inspection and after the annual financial report has been made to the Office, has been more thorough in detail than ever before. While particular attention has been paid to the new fund to see that it was being properly restricted and kept separate, the Hatch fund has received fully the usual amount of attention and has involved a large amount of correspondence to clear up doubtful points. Differences in classification of similar items have been quite noticeable and have prevented the reports of different stations being entirely comparable. Moreover, the classification is important in such items as buildings and land, where the amount which may be used is limited to 5 per cent. To secure greater uniformity and guard against improper classification, a circular was issued during the year upon Classification of Experiment Station Accounts, in which the classification was indicated of quite a large number of items concerning which there have been frequent questions and considerable lack of uniformity.

The following unexpended balances were reported by the stations the past year:

*Unexpended balances of the stations, 1906-7.*

Station.	Hatch.	Adams.
Colorado.....		\$243.78
Florida.....		1.92
Georgia.....	\$2.00	
Hawaii.....	1.39	
Illinois.....		135.62
Michigan.....	323.90	350.00
Minnesota.....		356.92
Montana.....		.05
Pennsylvania.....	.26	

These amounts will be automatically deducted from the appropriation to be received during the fiscal year 1907-8.

From a critical examination of the work and expenditures of the stations, it is safe to say that never before have the Federal funds for their support been so free from questionable expenditures or shown so large a return in work under way. This is partly due to a development of public sentiment which, while it protects these funds from infringement, spurs on the stations to greater activity, and partly to a clearer conception of the special field and functions of the experiment stations as distinguished from those of other agencies for agricultural instruction and advancement. Under the present circumstances the Federal funds invested in agricultural experiment stations are being economically and efficiently administered, on the whole, and are yielding large returns to American agriculture.

**REPORTS ON THE STATIONS.**

The following reports on the work and finances of the individual stations are based, like previous reports, on the results of personal inspection, the annual financial statements of the stations rendered on the schedules prescribed by the Secretary of Agriculture, and the printed and other reports of the stations.

**ALABAMA.**

**Agricultural Experiment Station of the Alabama Polytechnic Institute,  
Auburn.**

Department of the Alabama Polytechnic Institute.

J. F. DUGGAR, M. S., *Director.*

Agronomy and animal husbandry have been especially developed at the Alabama Station during the past year. The animal husbandry and dairying work has been organized as a distinct department in charge of D. T. Gray. The experiments in feeding beef cattle which have been carried on for three years in cooperation with the Bureau of Animal Industry of this Department have been completed and the



results arranged for publication. A number of new lines are contemplated, including determinations of the relative economy of various foods for pigs, maintenance rations for breeding ewes and cows, and the establishment of permanent pastures with Bermuda grass and bur clover as a foundation stock. In agronomy there has been variety testing on an extensive scale of the standard southern crops, rotation trials, and culture and other experiments.

Progress on the cane-sirup investigations of the chemical department was interrupted by the freezing of the canes, but the work has been continued during the present season. The chemist is also planning a study of sweet potatoes, cassava, and other starchy crops as sources of alcohol. In soil chemistry there have been studies of the effect of humification of nitrogenous substances on the availability of the phosphoric acid in soils, rye and sorghum, grown in large tiles sunken in the ground, being used as the experimental crops.

Corn breeding in cooperation with farmers has brought about an increase in yield of 30 to 40 per cent during the four years of work. The station has also cooperated with the Bureau of Plant Industry of this Department in a study of the shedding of the squares and bolls of the cotton plant. Resistance to alfalfa rust is being studied in a badly infected field, and a bulletin on the weeds of Alabama will soon be published.

The horticulturist has carried on a series of experiments in which cotton seed is being tried as a substitute for stable manure for hotbeds. In addition to the usual tests of orchard fruits and grapes, some attention is being given to basket willows, as the material for cotton baskets is becoming scarce. The horticulturist is cooperating with the Georgia Station in working out the nomenclature of the varieties of figs.

The entomologist resigned at the close of the year and was succeeded by W. E. Hinds, Ph. D., of the boll-weevil investigations of this Department, who began his duties November 1.

New lines of work have been inaugurated under the Adams fund on breeding peaches resistant to brown rot; breeding corn, cotton, and oats with reference to special points and study of the correlation of characters; cotton anthracnose and the character of resistance; relation between the soil and the composition of the cotton plant with reference to fertilizer requirements; effect of certain gases upon the peach root, and their effectiveness in destroying the borer; life history of the cowpea pod weevil and of several cotton insects; effect of different foods upon the quality of pork, especially the solidity of the fats; nature and cause of toxicity of cotton-seed meal to hogs; and bacteriological studies of the flora of the cow's udder in relation to the germ content of milk. In most of these lines considerable progress was made during the year.

The publications of this station received during the fiscal year included Bulletins 135, Diseases of sweet potatoes in Alabama; 136, Chickenpox or sore-head in poultry; 137, Experiments with oats; 138, Variety tests with cotton and corn; and 139, Injurious insects and their control; Circular 1, Two important scale insects and their control; the Annual Report for 1906; and an Index to Volumes 12 and 13.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	4,019.89
Balance from previous year, Adams Act.....	2,980.11
State appropriation.....	12,169.45
Farm products.....	329.51
Miscellaneous .....	1,449.28
Total.....	35,948.24

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The college is in a very flourishing condition, with over 600 students in attendance, of whom about 150 are in agricultural courses. A three-year degree course in veterinary medicine and surgery and a chair of animal industry have recently been established. A new engineering building, costing about \$15,000, is nearing completion, and work has been begun on a dining hall and dormitory. An appropriation of \$75,000 has been secured for a new agricultural building, on which work will begin in the near future.

**Canebrake Agricultural Experiment Station, Uniontown.**

F. D. STEVENS, B. S., *Director.*

The Canebrake Station has continued to develop its work along the more practical lines, with special attention to the growing of cotton, which is the money crop of the region. Variety testing has been carried on and some attention given to improvement by seed selection and better cultural methods. Subsoiling and deep plowing have been compared with the shallow cultivation in common use and a five-year rotation of crops, including a leguminous crop, has been completed. The station has also leased a tract of 20 acres of worn-out land adjoining its property, with a view to undertaking its restoration to its original fertility by means of commercial fertilizers and rotations of various legumes with cotton.

A leading problem in the region is the production of hay of good quality and alfalfa is regarded as of much promise. The station now has several acres of it under cultivation and has arranged for variety tests in cooperation with the Bureau of Plant Industry of this Department. Much interest is being manifested in this work by planters,

who are showing an increasing appreciation of the station work as a whole. The improved cotton seed produced and sold by the station meets with much demand.

No publications were received from this station during the past fiscal year. Its income was as follows:

State appropriation .....	\$2, 500. 00
Farm products.....	770. 78
Balance from previous year.....	716. 25
Total.....	3, 987. 03

The station receives no part of the Federal appropriations for experiment stations.

Since the close of the year a new director, F. D. Stevens, of the Bureau of Soils of this Department, has been appointed. It is planned to extend and broaden the scope of the work, especially on forage plants, plant breeding, and cultural methods.

**Tuskegee Agricultural Experiment Station, *Tuskegee Institute.***

Department of the Tuskegee Normal and Industrial Institute.

G. W. CARVER, M. Agr., *Director.*

The Tuskegee Station has confined its attention largely to variety tests of the common crops of the region, and to demonstrations throughout the county of improved farm practices. Bulletins were issued on the San José scale in Alabama (Bulletin 9) and on Saving the sweet-potato crop (Bulletin 10). The work with sweet potatoes had special reference to improved methods of harvesting and storing in order to increase the keeping qualities. The crossing and hybridization of cotton was begun with a view to producing a more prolific upland strain and one with a longer staple. There were also field comparisons of selected and unselected cotton seed, trials of varieties of corn as to silage value and of varieties of oats as to their value as cover crops and yield of grain and straw, tests with onions, peanuts, hairy vetch, clover, cabbages, and cowpeas, and some work with orchard crops.

The extension work has included monthly farmers' institutes, a short course, and practical demonstrations, both by cooperation with farmers and by means of an agricultural wagon equipped with improved machinery. About 135 farmers in the county now have plats of from 3 to 5 acres of corn and cotton under cultivation according to the methods recommended by the station, with results which already show great improvement in yields. This work is under the general supervision of the Bureau of Plant Industry of this Department, but is in charge of an agent of the station.

The income of the station during the past fiscal year was derived entirely from a State appropriation of \$1,500.

**ALASKA.**

**Alaska Agricultural Experiment Stations, Sitka, Kenai, Copper Center, Rampart, Kodiak Island, and Fairbanks.**

Under the supervision of A. C. True, Director, Office of Experiment Stations, United States Department of Agriculture.

C. C. GEORGESON, M. S., *Special Agent in Charge, Sitka.*

The Alaska stations at Sitka, Kenai, Copper Center, and Rampart have continued to make distinct progress in their respective lines of work, and new stations have been established at Kodiak Island and Fairbanks. There have been a number of changes in personnel, including the resignation of P. H. Ross as superintendent of the Kenai Station and the appointment of M. D. Snodgrass at Kodiak Island. J. W. Neal, who had been in charge of the Copper Center Station since its establishment in 1902, resigned February 1, and was succeeded by C. W. H. Heideman, but was later appointed as superintendent of the new station at Fairbanks.

The general business of the stations, which is centered at Sitka, has continued to increase. The special agent in charge has again cooperated with the Weather Bureau of this Department in establishing voluntary observing stations and in collecting and compiling the data received. In connection with the horticultural work of the station more than 12,000 fruit trees, chiefly apples, crab apples, plums, cherries, currants, raspberries, gooseberries, and strawberries, together with a few ornamental perennials, have been propagated at the nursery and distributed to settlers in various parts of the Territory, and, in cooperation with the Bureau of Plant Industry of this Department, garden and flower seeds were sent out to about 2,500 addresses. The reports received from these distributions are expected to afford valuable data as to the extent to which fruit growing and gardening can be carried on by the settlers. During the year samples of well-matured vegetables, including potatoes, carrots, cabbages, turnips, rhubarb, and a large cucumber, were received from a garden at Coldfoot, 60 miles north of the Arctic Circle, and formed a part of the stations' exhibit at the Jamestown Exposition.

As a result of the plant-breeding work about 3,000 hybrid strawberry seedlings and 500 hybrids of the cultivated raspberry and the native salmon berry are now under observation. Seedlings from wild and cultivated currants and gooseberries are also being grown, with a view to obtaining more hardy fruits through selection, and grafts of apples are being made upon a native species of crab apple. Variety testing of vegetables, especially potatoes, cabbages, and peas, has also been carried on. A yield of 379 bushels per acre was obtained from the Freeman potato, 60 per cent of the crop being of excellent

size, ripeness, and quality. It has also been demonstrated that Broad Windsor beans can be successfully grown.

At Rampart a small building was erected and considerable progress is reported in preparing the land for cropping. Although this station is situated about  $1^{\circ}$  from the Arctic Circle, winter rye and wheat and spring-sown barley and oats again, as in previous years, matured their crops, and nearly all kinds of hardy vegetables were successfully grown. Seed selection for earliness has been begun.

The Copper Center Station was again devoted chiefly to grain growing. Of the four crops that have been grown at the station since 1902 one fully matured and three others were injured by killing frosts. In 1906 a hard frost on August 24 injured all crops and they were cut and made into hay, of which 22 tons were sold at an average price of \$200 a ton. It is becoming evident that the rainfall in this valley is ordinarily insufficient for satisfactory crops, but it is hoped to demonstrate the possibility of supplementing it by irrigation.

The Kenai Station was entirely utilized for cattle raising, dairying, and the growing of the necessary winter forage. A method of haymaking has been worked out which is well adapted to the moist coast region. This system is described in Bulletin 3, Haymaking at Kenai Experiment Station, which bulletin, together with the Annual Report for 1906, comprises the publications of the Alaska stations during the fiscal year.

The special Congressional appropriation for live stock was utilized chiefly for the purchase of 20 additional Galloway cattle, so that the herd now numbers about 50. A part of the animals are quartered at Kenai, but on account of the increasing inaccessibility of this station it was deemed advisable to establish another breeding station on Kodiak Island. As yet no building or fences have been built at the island, but when this is done it is planned to transfer the entire herd to this location, which is well adapted to the purpose. A hardy breed of cattle is greatly needed in the Territory, and it is believed that the feasibility of their introduction is assured. In selecting the cattle preference has been given to animals with good milk records, and it is hoped that from them a dual-purpose type may be developed. The surplus stock is to be offered for sale to settlers. It is hoped ultimately to supplement the investigations with cattle with similar trials of a hardy breed of sheep and the Shetland and Iceland ponies.

About the close of the fiscal year a station was established near Fairbanks on the tract of 1,400 acres reserved by Presidential proclamation during the previous year. An equipment of tools and implements has been provided, and during the summer the Special Agent cleared and prepared for spring seeding about 10 acres. The station is located near the center of the Tanana Valley, which is estimated to

contain not less than 15,000 square miles of agricultural lands, and already has a considerable population. The location, soil, and exposure are deemed favorable to farming on an extended scale. The plan is to clear the land as rapidly as funds will permit, operating the station along ordinary farm lines for several years in order to ascertain whether practical farming can be made successful in the region.

The income of the stations during the past fiscal year was as follows:

United States annual appropriation.....	\$15,000.00
United States appropriation for live stock.....	3,000.00
Farm products.....	5,156.18
Total .....	23,156.18

These stations are doing an important work under pioneer conditions, in determining the agricultural possibilities of various sections and the most practical lines for development. The results are increasing in value with each succeeding year. The work with live stock is of special interest and is an essential factor in solving the problem of future agricultural development.

#### ARIZONA.

**Agricultural Experiment Station of the University of Arizona, Tucson.**

Department of the University of Arizona.

R. H. FORBES, M. S., *Director*.

The year at the Arizona Station has been characterized by the continuance and extension of the old well-established lines of work, and by the inauguration of several new projects especially with the funds made available by the Adams Act. A department of vegetable physiology and pathology has been established and equipped and the department of irrigation engineering has been materially strengthened. An assistant chemist has been added to the staff and all of the members have been freed very largely from instruction duties. In these ways the working time of the station has been nearly doubled. More commodious office and library quarters have been secured in the main building of the university and additional office facilities provided for handling the increasing amount of business.

The station has eight projects under the Adams fund, as follows: Investigations of the apple tree root rot; of certain tomato diseases characteristic of the Southwest; factors governing the culture of cacti and of saltbushes under range conditions; the rationale of the ripening of the date; study of toxic effect of copper compounds upon crops;

a physiological study of the sunburning of crops from muddy irrigation waters; and a study of the underflow of Rillito River. Work on these projects is well under way, and in several cases is already developing in an interesting way.

As a practical result of investigations relating to the alleged injurious effect of copper mine tailings on crops, an amicable settlement of matters in dispute between mining and agricultural interests in the district involved has been made possible. Other work at Tucson has included a study of trees and ornamentals suitable to planting in Arizona and tests of native and introduced grasses especially from South Africa.

The substation of 7.2 acres on the Colorado flood plain at Yuma, which is maintained by Territorial and sales funds, has been used for a demonstration of the possibilities of intensive culture. During the season of 1906, 4.73 acres planted mainly in alfalfa, potatoes, Bermuda onions, cantaloupes, and dwarf tomatoes produced crops valued at about \$1,000. These demonstrations have been of great practical value to the farmers of the region who, as a result of the station work, have recently organized a produce growers' association for the purpose of growing and marketing various early crops.

The date orchard established at Yuma in 1905 has made steady growth in spite of a short water supply. At Tempe, on the other hand, irrigation on surrounding land has caused the water table to rise almost to the surface level, but in spite of the saturated condition of the soil the date plants have thriven. A large number of suckers have been distributed by the station and put at the disposal of the Bureau of Plant Industry of this Department, with which the station cooperates in its date work. The Tempe orchard was found to be infested with scale insects (*Parlatoria blanchardii*), necessitating drastic pruning and scorching. The fruit product of the orchard in 1906, estimated to be about 4,000 pounds from about twenty-five varieties, but mainly Rhaes, was reduced to about one-tenth of this amount by the depredation of rats. The marketable product which was saved brought from 40 to 50 cents per pound in the local markets as novelties.

The station farm at Phoenix has been used as heretofore for the study of crop adaptations to the peculiar conditions of the region, seed selection by specific gravity, and means of modifying the extreme climatic conditions as affecting plant growth, particularly by shading. Among the crops which have been experimented with are olives for oil and for pickling, with which a fair measure of success was attained; cassava, taniers, taros, and avocados, which proved unsuccessful; tobacco which grew well but cured badly, and McNeal peas, which have proved very successful. The work in animal husbandry

has been confined mainly to sheep breeding and feeding experiments, the breeding consisting of crossing the Tunis and Shropshire breeds on the native grade Rambouillet to improve the mutton quality and hardiness of the latter, and the feeding experiments mainly of a comparison of alfalfa alone with mixtures of alfalfa with barley or oat hay.

During the year in addition to a collection of Timely Hints for Farmers as Bulletin 54, the station has issued Bulletin 53, Irrigating sediments and their effects upon crops, and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
Territorial appropriation.....	6,349.20
Farm products.....	1,802.87
Individuals.....	2,500.00
Fees.....	98.30
Miscellaneous, including balance from previous year...	1,486.19
Total .....	34,236.56

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The Arizona Station has improved its facilities during the past year, improved the conditions under which its staff works, and enlarged the scope of its work in both scientific and practical lines. Several important pieces of work have been brought to completion and new lines of work have been undertaken. That the value of the work to the Territory is recognized is shown by increasing financial support from the Territorial legislature.

#### ARKANSAS.

**Arkansas Agricultural Experiment Station, Fayetteville.**

Department of the University of Arkansas.

W. G. VINCENHELLER, *Director*.

The policy and lines of work of the Arkansas Station have not changed materially during the year except as necessitated by the inauguration of new projects under the Adams Act. The facilities for station work have been greatly improved through the completion and partial equipment of several new buildings, including especially the agricultural building and the dairy building. A farm of 80 acres, about 4 miles from the station, has been leased with the option of purchase for use as a hog and poultry farm, thereby supplementing the station farm, which is unsuited for work in agronomy and



animal husbandry and is representative of only a limited part of the soils of the State.

To provide for the special needs of the various sections, the last legislature established a substation in each of the six Congressional districts, with an appropriation for the ensuing biennium of \$1,500 annually in each case. Substantial recognition of the station work was also shown in additional appropriations aggregating for the biennium over \$60,000. Most of this amount is restricted to salaries and maintenance of the various departments, some of which will be occupied largely with State inspection work. For the first time a State appropriation (\$3,000 a year) is available for farmers' institutes, which are carried on largely by the station and are rapidly increasing in popularity.

The appointment of a number of assistants in various departments has relieved the heads of departments of much of the instruction work in the university and has permitted a greater differentiation of work with favorable results.

The Adams-fund projects inaugurated by the station relate to studies on the ticks of Texas fever; the relation of hog cholera and swine plague bacilli to contagious diseases of hogs; studies of anthrax and vaccination against it; the toxicity of cotton-seed meal; the losses in fertility in fruit growing; nature and cause of injury by apple twig blight; the physiological effects of pruning apple trees; and effects of artificially influencing sap pressure in relation to growth and other functions. In several lines the investigations already promise results of much importance.

Aside from these investigations, the chemist has summarized the meteorological observations at the station, has completed a study of the losses from the soil through drainage and the relation existing between rainfall and drainage water, and has conducted dietary studies at a men's club at the university and digestion experiments with cattle.

The dairyman has tested a succession of summer soiling crops for milch cows, practical methods of testing cream, and various washing powders.

The veterinarian is engaged largely with the problem of tick eradication in the State, but he is also studying purgatives, laxatives, etc., for hogs. A new law as to contagious diseases has been enacted under which he is charged with the control of such diseases in the State.

The agriculturist has begun investigations upon the effect on meat quality of attempting to breed fowls of high-egg production from general purpose breeds, and he proposes to undertake commercial poultry raising on the new farm. He is also experimenting with cowpeas in rotation with wheat versus wheat in continuous culture,

on the influence of breeding for high protein content on the yield of corn, and with alfalfa, clovers, grasses, and various other crops.

The work of the horticulturist has included demonstrations in handling a run-down orchard, experiments with methods of culture and fertilizer tests with strawberries, the pruning of potatoes, miscellaneous observations and experiments with asparagus, rhubarb, grapes, onions, spring and winter cabbage, and ornamental shrubs and trees, and tests in cooperation with the Bureau of Plant Industry of this Department of Hungarian apples and citrus fruits.

During the fiscal year four bulletins and an annual report were received from this station as follows: Bulletins 92, Some insects of orchard and other fruits; 93, Cattle tick eradication in northwest Arkansas; 94, Rice culture; and 95, Notes on spraying and suggestions for combating crop pests; and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation.....	8,063.57
Farm and dairy products.....	5,339.68
Total.....	35,403.25

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

Conditions in general have been made more favorable for efficient agricultural investigation at this station during the past year. The staff has been enlarged and strengthened and many new lines of work undertaken. The station deserves the increasing support it is receiving from the State.

#### CALIFORNIA.

**Agricultural Experiment Station of the University of California, Berkeley.**

**E. J. WICKSON, A. M., Director.**

The California Station has continued the lines of former years, but there has also been some extension, chiefly through State appropriations for substations and specific investigations. Among these was an appropriation of \$132,000 for the current biennium for buildings, equipment, and maintenance at the new university farm at Davis. A dairy building and stock-judging pavilion have been erected on this farm and plans are under way for a dairy barn, cereal laboratory, carpenter and blacksmith shops, and a waterworks system. The land is gradually being put in shape for experimental and instruction work. Field experiments are to be conducted in a number

of lines, e. g., irrigation, cereals, vegetables, and fruits, together with feeding trials with live stock. It is expected that the farm will also be utilized in part for a secondary school of agriculture, short courses, and for practical work by the college of agriculture of the university.

A pathological laboratory for the study of plant diseases has been opened at Whittier, for the maintenance of which, jointly with the citrus substation at Riverside, a State appropriation of \$17,500 per annum is available, and new buildings have been erected at the forestry station at Santa Monica. The substation at Riverside has been used chiefly for fertilizer, cultural, and other experiments with fruits, and that at Petaluma with poultry.

Considerable attention has been devoted to the cereal investigations which have been carried on at Yuba City, Modesto, and Tulare, partly in cooperation with the Bureau of Plant Industry of this Department. The work has thus far been chiefly with wheat, including fertilizer, variety, cultural, and rotation trials, breeding work, chemical analyses, and milling and baking tests, but it is planned to take up barley, oats, and rye in much the same way.

The station has inaugurated nine projects to be maintained wholly or in part from the Adams fund. These relate to the relation of the soil and its treatment to chlorosis of citrus fruits; vitality and reproductive power of native species of trees; study of certain plants in the Santa Barbara district in relation to climatic requirements, etc.; the California peach blight; artificial immunization of cattle against tuberculosis; action and efficiency of various materials in prevention of seepage of irrigation waters; extent and character of toxic action of various arsenical poisons used against insects; nature and communicability of California vine disease; and metabolism experiments with poultry upon the availability of highly nitrogenous feeds. Several of these projects receive only a small amount of money from the Adams fund, the amount being supplemented from other funds. Work upon one of them was temporarily discontinued at the close of the year.

Other work of the station has included a special investigation of vine hoppers, the collection of data on California practices in bee keeping, studies of dry wine making at Fresno, studies of sanitary milk, and, in cooperation with farmers, feeding trials with pigs, dairy cattle, and sheep. The studies of the nutritive value of fruit and nuts were continued to the close of the year in cooperation with this Office as a part of its nutrition investigations.

During the year ten bulletins and seven circulars were received from the station as follows: Bulletins 178, Mosquito control work in California; 179, Commercial fertilizers; 180, Resistant vineyards; 181, The selection of seed wheat; 182, Analyses of Paris green and lead arsenate; 183, The California tussock moth; 184, Report of the

plant pathologist to July 1, 1906; 185, Report of progress in cereal investigations; 186, Oidium or powdery mildew of the vine; and 187, Commercial fertilizers; Circulars 19, The disinfection of stables; 20, Reading courses in irrigation; 21, The advancement of agricultural education; 22, Defecation of must for white wine; 23, Pure yeast in wineries; 24, Olive pickling; and 29, Preliminary announcement concerning instruction in practical agriculture upon the university farm.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000. 00
United States appropriation, Adams Act.....	6,926. 84
Balance from previous year, Adams Act.....	73. 16
State appropriation.....	79,628. 48
Local community and individuals.....	490. 98
Fees.....	9,593. 34
Farm products.....	1,531. 10
Miscellaneous.....	25,621. 32
Total .....	138,865. 22

An additional State appropriation of \$103,290 was expended for the purchase of the university farm at Davis, which, under the terms of the act providing for its establishment, "shall be so conducted as to meet the needs of persons who desire instruction in agriculture, horticulture, viticulture, animal industry, dairying, irrigation, and poultry raising, and to prepare them for the pursuit thereof; and shall be used for experimental and investigational work in connection with the agricultural experiment station of the University of California."

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the California Station is increasing in scope and importance. With the appointment of an experienced officer as permanent director and the enlargement of its equipment and resources there is good reason to believe that this station is entering on a period of greatly enlarged usefulness as a factor in the agricultural development of the State.

#### COLORADO.

##### *Agricultural Experiment Station, Fort Collins.*

Department of the State Agricultural College of Colorado.

L. G. CARPENTER, M. S., *Director.*

The year at the Colorado Station has been a formative period pending the readjustment of the work to the changed conditions brought about by the Adams Act and increased State appropriations.

The passage of the Adams Act has made possible a more complete differentiation of college and station duties, the heads of departments being enabled to devote more time to station work and the assistants doing more teaching. With the State funds a number of specific enterprises have been developed, especially along extension and co-operative lines. The general business of the station has increased and its equipment considerably augmented.

The station has six projects under the Adams fund, these relating to breeding wheat for higher altitudes, and a study of the effect of irrigation water on milling qualities; the composition, heat value, and digestibility of hays with special reference to lesser known bodies; investigations on several plant lice; the relation of bees to the transmission of blight; seepage investigations and the flow of water through soils; and studies of alfalfa blight, tomato blight, and raspberry yellows. Special phases of these investigations were entered upon during the year and considerable progress made.

Aside from the investigations under the Adams Act, the chief features taken up have been horticultural and entomological studies in connection with the "western slope fruit investigations," including a study of black peach aphid, which has recently made its appearance; potato investigations in different parts of the State; the development of a rust-resistant cantaloupe; feeding experiments with hogs, sheep, and cattle, including a study of the relations of pasturing to feeding; a large amount of breeding, variety, and culture work with wheat, barley, alfalfa, peas, flax, sugar beets, corn, and other crops, and, in cooperation with the Bureau of Animal Industry of this Department, the continuation of the breeding work to develop an American carriage horse. The irrigation survey of the State was continued, a systematic orchard survey was undertaken, and there was considerable cooperative work in agronomy, one phase being the competitive growing of peas by school children.

During the year the extension and farmers' institute work was re-organized under the direction of the former animal husbandman. Over 100 one-day institutes were held during the summer, besides short courses at different points in the State on the plan of movable schools. One of these, held at Delta, with courses in fruit growing and domestic science, had an enrollment of over 125, in spite of the fact that in order to promote regularity in attendance a small fee was charged for the work. There was also a short course in forestry, which was attended by many of the rangers from the National forests.

At the last session of Congress, a section of land was ceded to the college for use in forestry work. The State legislature made an appropriation for the purchase of about 80 acres of land for the

college and station and authorized, for the same purpose, the use of 10 per cent of the funds arising from the sale of lands under the original Morrill Act. For the ensuing biennium \$10,000 was granted for farmers' institutes, and the station received \$27,500, provision being made for investigations in animal, plant, and fruit industry, horse breeding, and diseases of live stock, and for the construction of a grain storehouse and the purchase of farm machinery. The college was enabled to reinstate its course in veterinary science which was discontinued on account of lack of funds and the former horticultural building has been converted into a veterinary hospital. The farm equipment of the college has been largely increased by donations from manufacturers and the course in farm machinery has proved very successful. As a new feature, two-year practical courses in agriculture, domestic science, and farriery have been organized to continue for five months each year during the winter. The number of four-year students in agriculture has now increased to over 100, and the institution, as a whole, is in a flourishing condition.

The publications received from the station during the fiscal year included Bulletins 100, Flora of Colorado; 113, Larkspur and other poisonous plants; 114, Insects and insecticides; 115, Fertilizer experiments with sugar beets; 116, The cottony maple scale; 117, The Colorado potato industry; 118, Report of the field horticulturist for 1906; 119, Western slope fruit investigations, 1906; 121, Notes on alfalfa and sugar beets, Cantaloupes; and 122, Fruit growers' associations; and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation .....	2,364.52
Miscellaneous.....	7,497.68
Total.....	31,862.20

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the Colorado Station is more fully meeting the needs of the various agricultural interests of the State. Under present conditions it is very important that the more scientific enterprises of the station should be strongly encouraged, while the more popular work and local operations are at the same time liberally supported. The recent action of the State legislature in providing funds for station enterprises is very encouraging.

## CONNECTICUT.

**The Connecticut Agricultural Experiment Station, New Haven.**

**E. H. JENKINS, Ph. D., Director.**

The Connecticut State Station has again concentrated its investigation work along the lines of plant breeding, entomology, plant diseases, and forestry, together with researches on the vegetable proteins under a grant from the Carnegie Institution. By an act of the State legislature the Federal funds under the Adams Act were equally divided between the State and Storrs stations, and the former confined its portion to investigations in one department, relating to principles and the correlation of characters in the breeding of corn and potatoes. The work was started in a thorough and systematic manner and promises important results.

Other work in plant breeding has included studies of correlated characters with clovers of various kinds for the purpose of finding relations between valuable commercial characters which are judged with difficulty, and physical and chemical characters which are more easily recognized and can be distinguished in the young plant. A study of the physiology of the production of seed and the difficulties attending hybridization in the potato has been completed, over 700 varieties having been under observation. In connection with the breeding work fertility experiments are in progress at a rented farm outside the city and cooperative tests with farmers are under way with wheat and dent corn, beets, tomatoes, and other crops, besides field, pot, and laboratory experiments in which feldspar is being compared with sulphate of potash for tobacco.

A new orchard pest, the peach sawfly, hitherto undescribed, was discovered in great abundance in one section of the State where it threatened great injury by defoliating the trees. The life history was determined and spraying with arsenate of lead was found to be an effective means of control. An aggressive campaign has been waged against the gipsy moth, which has made its appearance in the State at Stonington, where about one square mile is infested. An attempt has also been made to discover a means of fumigating nursery stock by the use of some substance less dangerous to health than hydrocyanic-acid gas.

The botanist is assisting in the State natural history survey in working out the molds and is studying methods of treatment for potato blight, the alternate stages of rust, the wilt of tomatoes, and the root rot and calico diseases of tobacco. It has been learned that calico may be transmitted by mechanical means, by worms, or by watering with tobacco water.

The forester has under way additional experiments in the economic planting of white pine, and is comparing fall with spring planting. A forest survey has been made of Litchfield County, all wood lots of

over 10 acres being platted on topographic sheets. The forest nursery has been enlarged and now contains between 800,000 and 1,000,000 seedlings. A part of these are to be sold at cost for private plantings. These are rapidly increasing, over 350,000 seedlings of white pine alone being set out in 1907. The State forests, which are in direct charge of the station forester, have also been enlarged and a planting made of about 50 acres.

The State inspection work required of the station continues to be very heavy and now includes the analyses of samples of fertilizers, foods, and feeding stuffs, and the inspection of nurseries. A new pure food law was enacted to secure greater uniformity with the Federal pure food and drugs act.

The publications received from the State Station during the fiscal year included Bulletins 154, Chestnut in Connecticut and the improvement of the wood lots; and 155, The elm leaf beetle; and parts 1 to 5 of the Annual Report for 1906. Parts 1 to 3 of this report are devoted to the results of the inspection of fertilizers, food products, and commercial feeding stuffs, part 4 to the report of the entomologist, and part 5 to the report of the botanist.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$7,500.00
United States appropriation, Adams Act.....	3,500.00
State appropriation, including balance of \$350.....	16,850.00
Individuals .....	8,300.00
Fees .....	4,428.62
Miscellaneous .....	72.12
Total.....	40,650.74

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

In connection with an attempt to bring about the removal of the college and station at Storrs to a more central and accessible location the question was raised as to the removal of the State Station as well "to the same place, from its present too valuable site in an aristocratic residential section of New Haven, where land values are increasingly high." No steps were taken as to the removal of the institution at Storrs, but a commission was appointed to consider the remaining agricultural institutions of the State, thereby creating some uncertainty as to the future status of the State Station.

**Storrs Agricultural Experiment Station, Storrs.**

Department of the Connecticut Agricultural College.

L. A. CLINTON, M. S., *Director*.

The work of the Connecticut Storrs Station has centered mainly around its projects under the Adams Act. The projects were outlined



as follows: Nature of fermentation of silage; the cause of decay in eggs; studies in dairy bacteriology, especially the sources of harmful bacteria, types of lactic bacteria, and the associated action of various organisms; investigations in the making of foreign types of cheese; and breeding beans and sweet corn with reference to special points. The work on foreign cheeses was in cooperation with this Department, and has involved a thorough study of the chemical and bacteriological conditions as well as of the practical methods of manipulation. The work in the bacteriology of milk has already resulted in some important developments.

Aside from its Adams projects, the station continues to give particular attention to its poultry investigations. An extensive study of squab raising has been completed and the conclusions as to its profitability have been embodied in a recent bulletin. Another problem being considered is the possibility of reducing the expenses in poultry raising, especially as to labor and housing. Individual records are being kept of chicks from incubation to laying, and a study has been begun of Mendel's law in poultry crosses.

Following a State appropriation to the college of \$50,000 for a new greenhouse and a horticultural building the station has been given the use of the old greenhouse which will be a valuable adjunct in its work. The horticulturist has under way fertilizer trials with cauliflower, variety tests of tomatoes and melons for spraying experiments, and a cooperative experiment at Yalesville with corn crops for orchards. A new spraying mixture for San José scale has been devised and tested on several hundred trees with good results. The mixture is a petroleum emulsion, the ingredients of which consist of an emulsifier made up of carbolic acid, fish oil, caustic potash, kerosene, and water, to which are added in turn crude petroleum, rosin oil, and water, making a milky solution from which the oil does not separate for several weeks.

In dairy work a test has been made of milking machines and also of the use of covered milk pails in the production of clean milk. The position of dairyman was filled during the year by the appointment of J. M. Trueman, of the Illinois University and Station. The former dairyman, C. L. Beach, has recently been elected president of the college, vice R. W. Stimson, who has resigned to accept the presidency of Smith's Agricultural School at Northampton, Mass.

The station is doing considerable extension work, chiefly through farmers' institutes and other farmers' organizations. The college is giving much attention to short courses, these including forestry, creamery practice, dairying, pomology, and poultry raising. The summer school for teachers continues to be quite successful.

An attempt in the legislature to remove the college and station to a more central and accessible location was unsuccessful. A division

of the Adams fund between the Storrs and State stations was effected, each station receiving one-half the fund, as is the case under the Hatch Act.

The publications received from the Storrs Station during the fiscal year were as follows: Bulletins 42, Quality of milk affected by common dairy practices; 43, The facility of digestion of foods a factor in feeding; 44, Poultry observations; 45, The apple leaf-miner; and 46, Directions for making the Camembert type of cheese; and the Annual Reports for 1905 and 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$7,500.00
United States appropriation, Adams Act.....	3,500.00
State appropriation.....	1,800.00
Balance from previous year.....	1,222.27
Miscellaneous.....	435.08
Total.....	14,457.35

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The station is making a good showing for the funds at its disposal, which are economically administered. In a number of lines it has interesting and important investigations in progress, the value of which is not confined to the boundaries of the State.

#### DELAWARE.

**The Delaware College Agricultural Experiment Station, Newark.**

Department of Delaware College.

H. HAYWARD, M. S. Agr., *Director*.

The year at the Delaware Station has been a period of reorganization, involving many changes in personnel, eight of the eleven members of the staff, including the director, being appointed during this time. The horticulturist was succeeded by C. A. McCue, of the Michigan College and Station, and the mycologist by M. T. Cook, of the Cuban Experiment Station, as plant pathologist. Toward the close of the year the chemist and his assistant resigned to accept positions with the Pennsylvania College, and the agronomist was succeeded by A. B. Grantham, of the Missouri Station. With so many changes the conditions have been somewhat unsettled and the work retarded.

The year was also marked by the acquisition, at a cost of \$20,000, of a farm of about 200 acres, suitable for instruction and experimental purposes. This farm is located about a mile from the station

on one of the main thoroughfares leading into the town. A lack of funds has prevented its complete equipment and proper maintenance, but considerable experimental work was planned and carried out during the season of 1907, including variety, culture, rotation, and fertilizer experiments with various crops, among which were corn, cow-peas, crimson clover, and grasses. Orchards have been planted and other lines of horticultural work begun. Work in animal husbandry is contemplated in the future when funds are available and some stock has been secured for the purpose, but for the present experimentation on the farm is to be confined to plant production.

Work outlined by the station under the Adams Act included investigations upon the sources of infection of anthrax, forage poisoning, soil bacteriology in relation to the setting free of plant food, cause and nature of immunity and disease resistance in plants, the functions of tannin in the economy of plants, crown gall of the genus *Rubus*, laws governing the rate at which nitrogen is taken up by red clover, estimation of available plant food in soils, and effect of light from the Cooper-Hewitt mercury vapor lamp on plant growth. The work was somewhat interrupted by a number of changes in the staff during the year. That upon the last three projects is said to be practically completed. In at least two other lines it is held in abeyance for the present, but is expected to be resumed later.

In addition, studies supplementing the important work of the chemist on soluble oils and oil emulsions have been made by the entomologist of the effect of soluble oils upon the San José scale and upon the foliage of trees when used as a summer spray, together with work on corn insects, and the apple and blackberry leaf-miner. It has been found that miscible oils may be mixed with standard Bordeaux mixture and that heavy oil emulsions are effective insecticides for the San José scale at 10 per cent strength.

The horticulturist has been studying the economics of Delaware horticulture, breeding potatoes for resistance to *Phytophthora infestans*, hybridizing apples to produce an early red variety of good quality, and studying the control of San José scale on nursery stock, the effect of spraying when in bloom for spur blight, the effect of an excess of lime in Bordeaux mixture, its efficiency in controlling scab, and the amounts of copper sulphate best suited for this purpose. The agronomist has been occupied chiefly with plans for the experimental field work on the new farm. His investigations are to center around the problem of soil fertility, which is of much importance in Delaware on account of the small amount of manure produced in the State and the wide use of green manuring crops and commercial fertilizers. Field tests are already in progress with various combinations of fertilizers with green manuring crops to determine to what extent they may replace and supplement fertilizers in crop production and

in permanently maintaining the fertility of the soil. There is also some work in corn breeding. A preliminary study of Delaware seed corn indicated that but little care is now exercised in its selection and that a large percentage is low in germinating quality.

The publications received from this station during the fiscal year were Bulletins 75, Petroleum emulsions; 76, Third report on dust and liquid spraying; and 77, A study of Delaware seed corn, with some suggestions for its improvement; Circulars 1, Some practical directions for making oil emulsions; 2, The strawberry root louse; and 3, Two common scale insects; and the Annual Report for 1903.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$14, 944. 03
Balance from previous year, Hatch Act.....	55. 97
United States appropriation, Adams Act.....	2, 050. 34
Balance from previous year, Adams Act.....	4, 949. 66
State appropriation.....	67. 01
Farm products.....	14. 07
Miscellaneous.....	809. 07
Total.....	22, 890. 15

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The numerous changes in organization during the past year have necessarily retarded the work of the Delaware Station, but it is being well organized and its work judiciously planned. The new farm, if adequate provision is made by the State for its proper equipment and maintenance, will add greatly to the scientific value and practical usefulness of the work of the station. The earnest efforts now being made to strengthen and develop it should have the cordial support of the governing board and of the agricultural interests of the State.

#### FLORIDA.

**Agricultural Experiment Station of Florida, Gainesville.**

Department of the University of the State of Florida.

P. H. ROLFS, M. S., *Director.*

The year at the Florida Station was largely occupied in the removal of the offices and laboratories from Lake City to Gainesville, and the consequent readjustment of the work to the new conditions. The office of the director was established at Gainesville January 1, 1907, and the transfer of equipment was completed in April. Seven farm buildings have been erected besides a storage building, a gardener's cottage, and a substantial propagating house in which are rooms for the plant pathologist, plant physiologist, entomologist, and botanist. The main laboratories are temporarily located in one of the college

buildings pending the erection of a special station building, for which the last legislature appropriated \$40,000. The entire expenses of moving and reequipment were also defrayed by the State.

At Gainesville the station is well provided with land for experimental purposes. A tract of 57 acres which has been divided into experimental plats is considered specially satisfactory, as the land is practically level and extremely uniform in texture and other physical properties. About 60 acres of "hammock" land are available for horticultural work, of which 18 acres have already been cleared, put in good tilth, and subdivided for vegetable growing, orchards, and miscellaneous work and novelties. There are also about 60 acres suitable for cropping purposes and a stock range of about 150 acres now mostly heavily timbered with hard wood.

For the most part, the experimental work in progress at Lake City has been continued, although some of the horticultural and field work was of necessity given up.

The station has undertaken with the Adams fund studies of soils and fertilizers in relation to plant growth and development, especially on pineapple and citrus fruits; the nature and cause of several diseases of citrus trees; and parasites of the white fly. These studies have been planned with a good deal of care, and sufficient funds have been set aside in each case to carry them out on an efficient basis.

In the chemical department the leaching of soils has been studied, especially as to losses of nitrogen, phosphoric acid, and potash, and the influence of cultivation on leaching. Other soil studies deal with soil acidity, the amount of lime taken up by different plants and the effect of muck on capillarity, a part of the work being carried on by means of pot experiments.

The department of animal husbandry is conducting feeding trials with steers, dairy cattle, and pigs to determine the relative value of a number of local feeding stuffs. Cocoanut meal has been found to have about one-half the value of cotton-seed meal for dairy cattle. In cooperation with stockmen an attempt is being made to improve the native or "piney woods" cattle by means of Shorthorn or Holstein bulls. The cost of production of beef, milk, and pork is also being investigated.

Other miscellaneous lines of work include plant-breeding problems, especially with cotton, alfalfa, cowpeas, beggar weed, velvet bean, and other forage crops; the diseases of celery, lettuce, and roselle; the pecan and rose mildews; the fermentation of Japanese persimmons; the fertilization of citrus fruits and apples; and variety testing of Irish potatoes. Much of this work has been in cooperation with farmers. Members of the staff participated in a single farmers' institute and a number of local meetings. After a lapse of two years a State appropriation of \$5,000 is again available for farmers' insti-

tutes for the ensuing biennium, the management of the work being entrusted to the director of the station.

The publications received from this station during the past fiscal year were as follows: Bulletins 86, Salt sick (Bovine uncinariasis); 87, Soil studies; 88, Whitefly conditions in 1906; The use of the fungi; and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation .....	19,524.26
Fees .....	55.00
Farm products .....	550.74
Total.....	42,130.00

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The outlook for the Florida Station is promising. The station is now well established in its new environment, and the more complete differentiation of the university and station work while causing numerous changes in personnel is apparently working out to the great advantage of the station.

#### GEORGIA.

##### Georgia Experiment Station, *Experiment.*<sup>a</sup>

Department of Georgia State College of Agriculture and Mechanic Arts.

M. V. CALVIN, *Director.*

The Georgia Station has made few changes in its lines of work or its personnel, except that since the close of the year the work in animal industry has been materially increased and further differentiated and T. H. McHatten has succeeded H. N. Starnes as horticulturist.

The investigations outlined for the Adams fund are as follows: Nitrifying and denitrifying bacteria of the soil as affecting soil fertility; nitrogen-gathering bacteria of legumes; organisms producing sweet curdling of milk; attenuated cultures of tubercle bacilli in relation to immunity; Mendelian and De Vriesian laws in their application to the cotton plant; atavism and vicinism in the cotton plant; relation between host and parasite in cotton anthracnose; crown-gall investigations; wilt of Japanese plums; botanical study of fig varieties; and studies in Smyrna fig culture. Work has been actively inaugurated in only a portion of these lines. A change in the staff has made the continuance of several of them uncertain.

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<sup>a</sup> Telegraph, freight, and express address, *Griffin.*

Field trials with corn and cotton and fertilizer and variety tests have been continued, with particular attention centered upon forage crops. Soy beans, sorghum, rape, peanuts, and other crops have been compared for the production of green forage as well as for their feeding value.

The station is cooperating with the Bureau of Animal Industry of this Department in dairy experiments and demonstrations and in preventive inoculation for tuberculosis. A Hindu bull has been secured from a recent importation and breeding experiments are being carried on to test the immunity of this breed and its crosses to tick fever. Experiments in finishing Tennessee steers for market have been brought to a close and the results recently embodied in bulletin form.

As a result of feeding trials with pigs it has been found that cotton-seed meal may be safely fed in quantities of at least 2 pounds per day, provided a mixture of charcoal, lime, and copperas is added to the ration. A preliminary comparison of skimmed milk and corn meal for pigs showed marked differences in the proportions of fat and lean meat upon slaughter. The test is to be repeated in an attempt to determine the effect of a balanced ration.

A preliminary study on the crown gall has been completed and the results are nearly ready for publication. The work on the wilt of the Japanese plums has been continued, but the studies of Smyrna figs had to be suspended, as all the trees were frozen to the ground in December. The Stringfellow method of pruning has been tested, with results which indicate that it is especially adapted to the planting of peaches. Arrangements have been made to study methods of peach culture on an extensive scale through cooperation with several large growers.

The publications of this station received during the fiscal year included Bulletins 72, Fertilization; 73, The peach-tree borer; 74, Corn culture; and 75, Cotton culture.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation.....	780.84
Farm products, including live stock.....	3,033.47
Balance from previous year.....	3,459.88
Total .....	29,274.19

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

**HAWAII.****Hawaii Agricultural Experiment Station, Honolulu.**

Under the supervision of A. C. True, Director, Office of Experiment Stations,  
United States Department of Agriculture.

JARED G. SMITH, B. S., M. A., *Special Agent in Charge.*

The general problem confronting the Hawaii Station has continued to be the diversification of agriculture in the islands. Attention has been directed especially to the introduction of tobacco, cultivation of rice and rubber, fruit growing for export, and bee keeping as profitable supplements to sugar, which is now the one crop of importance. The station funds for this work were considerably augmented by a Territorial appropriation of about \$6,000 and contributions from private individuals and corporations of nearly \$7,000. This increase in funds has made possible a material extension and development of the station work along these lines.

In the tobacco investigations, for which private contributions aggregating about \$4,000 were available, the station raised, cured, and fermented about thirty bales of Sumatra, Cuban, and other tobaccos which buyers pronounced of excellent color, texture, and burn. It is believed that the station has definitely established the fact that cigar leaf tobacco can be profitably produced on a commercial scale in favorable districts of Hawaii, and the work has been left to private enterprise.

Some very promising experiments in the tapping of rubber trees have been begun, from which systems of tapping, collecting, and coagulating the latex have been worked out which seem well adapted to use. More than \$500,000 has recently been invested in rubber growing in the islands, and in view of the increased importance of the crop the results of the station work are regarded as of great value.

In the experiments with rice a large number of new varieties have been introduced through the cooperation of the Bureau of Plant Industry of this Department, some of which are greatly superior to the mixed strains now being grown. Among these are an Egyptian sort of excellent milling qualities, a strain from Georgia, and a Japanese variety which produces a crop in three-fourths the time required for the maturity of the Hawaiian variety, thereby permitting better drainage between crops and more thorough preparation of the soil. Selections have also been made from individual plants of Hawaiian rice which are more prolific and of better milling qualities than those now grown. From tests of three varieties of dry-land rice it has been determined that these sorts produce a better crop without irrigation and that they may fill a very important need in



the Territory in the production of grain, hay, and forage. Other work with rice has demonstrated that an increase in the yield of grain may be secured by the use of commercial fertilizers, and some tests of machinery new to the islands have indicated its great superiority over the primitive Chinese methods now in vogue.

The horticulturist has materially increased the permanent orchards of the station, especially the collection of cacao, inarched mangoes, papayas, citrus fruits, avocados, and other tropical fruits, and has supervised an experimental planting of two deciduous orchards at altitudes of 3,000 and 5,000 feet, consisting of apples, pears, plums, peaches, apricots, cherries, walnuts, almonds, and figs. An experimental shipment of fruit to the mainland demonstrated that with care in picking and packing and proper fumigation with formaldehyde gas, the important tropical fruits of Hawaii can be profitably marketed in the cities west of the Rocky Mountains.

The principal line of work of the entomologist has been in connection with bee keeping in Hawaii. A large part of the honey produced is what is known as "honeydew honey," obtained from the secretion of insects attacking sugar cane and other sugar-producing plants, and another portion is a mixture of the honeydew honey with that from floral nectar. Analyses by the station chemist have shown that these types, though not artificially adulterated, were in marked divergence from the existing standards, but through the efforts of the station a classification of the honeydew honey has been established which will be of great advantage to the producers. An investigation has also been begun on the feasibility of feeding back inferior grades of honey for the production of wax, for which much higher prices are obtainable.

Miscellaneous investigations have also been begun by the entomologist on the insects affecting live stock, stored products, household pests, etc., and special attention is being given to the pests attacking the pineapple and rubber plantations. For the control of the pineapple scale and pineapple mealy bug, treatment with hydrocyanic-acid gas has been found both profitable and efficient. In cooperation with the local board of health in its campaign for the extermination of mosquitos, several hundred top minnows were introduced from Texas. These have multiplied rapidly, and wherever present have effectively cleared the water of mosquito larvæ and eggs.

Other work has been continued along the lines of previous years. The Special Agent has collected data regarding the status of the rubber industry, the growing of grapes, and sisal production. The chemist was transferred to the Bureau of Soils of this Department, but an assistant chemist was appointed and the routine work has been continued, including analyses of honey, soils, water, rubber, and feeding stuffs. Efforts are being made in cooperation with the Territorial

veterinarian to correct the deficiency of lime in local feeding stuffs by the addition of bone meal to the ration. The station has also cooperated with other branches of the Territorial and Federal governments, notably in cement analyses for the United States Army Engineer Corps, analyses and examinations of imported goods for the collector of customs, and the Navy Department in sending collections of seeds and plants to the naval stations at Guam, Tutuila, and the Philippines.

During the year three press bulletins were issued as follows: Press Bulletins 17, The mango weevil; 18, All about the Hawaii Experiment Station; and 19, A preliminary report on rice investigations. The results of a cooperative study of fungus diseases of Hawaiian crops other than sugar, by Dr. N. A. Cobb, of the Bureau of Plant Industry, and formerly of the Hawaiian Sugar Planters' Station, will be published later.

A special Congressional appropriation of \$5,000 was available for the installation of a water system. In constructing this a corrugated galvanized-iron roof about 200 feet square was built on a hillside overlooking the station at an elevation of about 1,200 feet, the slope of the roof conforming to that of the hill. Gutters attached to this roof drain into a 30,000-gallon redwood tank, which in turn leads to two 60,000-gallon tanks, one of which is used to supply the station buildings and the other the various station fields. With an average rainfall amounting to 120 inches per annum on the upper portion of the station grounds, this system will yield more than 1,000,000 gallons of water, which guarantees fire protection and insures an adequate water supply to the experimental plats at all times.

The income of the station during the present fiscal year was as follows:

United States appropriation.....	\$15,000.00
United States appropriation for water supply.....	5,000.00
Insular appropriation.....	6,140.95
Individuals.....	6,976.80
Farm products.....	400.88
Total .....	33,518.63

**Hawaiian Sugar Planters' Experiment Station, Honolulu.**

C. F. ECKART, M. S., *Director of Division of Agriculture and Chemistry.*

The work of the Hawaiian Sugar Planters' Station has continued along the general lines of past years. In the division of agriculture and chemistry Noel Deerr has been appointed assistant director and Dr. R. S. Norris assistant chemist. Considerable attention has been given by the division to cane improvement by the selection of seedling canes. From 5,232 seedlings originally planted, about 355 va-

ieties have been retained, which will be tested both at the station and also on the numerous substations in order to ascertain their value under the varied climatic conditions encountered in the sugar-growing regions of the islands. Artificial cross-pollination has also been attempted, and in spite of unfavorable weather has yielded ten seedlings, of which five survived and are available for future work. Investigations have been continued at the substations to determine the value of fertilization, the stripping of cane, and other agricultural practices under plantation conditions.

The chief work of the division of entomology has continued to be the study of the leaf-hopper and its parasites. It is believed that the ravages of this insect have been checked to a remarkable degree by the introduction of parasites, although in a few places leaf-hoppers are still somewhat abundant, probably because of local climatic conditions. A regular inspection of the plantations is carried on by two members of the staff. The Hawaiian cane borer is also being studied, especially with reference to its natural habitat, which is being sought in China, the Malay States, and Java.

During the year Dr. N. A. Cobb resigned the directorship of the division of pathology and physiology to accept an appointment with the Bureau of Plant Industry of this Department and was succeeded by L. Lewton Brain, the former assistant director of the division. The appointment of an assistant pathologist has been authorized. Noteworthy contributions have been made to the knowledge of root diseases, from which it is thought that there are at least three Basidiomycetous fungi attacking the cane roots. These differ somewhat in their macroscopic appearance and method of attack, so that they can be distinguished in the absence of fructifications. This investigation is arousing much interest among planters, who show a readiness to attempt the suggestions of the division, and in a number of cases are actively cooperating through field experiments bearing on lines of treatment for these diseases. Bordeaux mixture has been found to give the most satisfactory results for the protection of cane cuttings against the so-called "pineapple" disease and is being extensively used for this purpose.

The division is also investigating "red rot" of the stem and a number of other diseases. Some interesting observations were made as to the resistant properties of a number of new varieties to the leaf disease known as "eye-spot," which was widely prevalent during the winter.

The publications of the station received during the fiscal year were as follows: Division of agriculture and chemistry, Bulletins 16, The influence of stripping on the yields of cane and sugar; 17, Comparative tests with varieties of sugar cane; 18, Hawaiian waste molasses, and 19, Lysimeter experiments; division of entomology, Bulletins 2,

Notes on some Fijian insects, and 4, Parasites of leaf-hoppers, Leaf-hoppers; division of pathology and physiology, Bulletins 4, Some elements of plant pathology; 5, Fungus maladies of the sugar cane; and 7, A lecture on rind disease of the sugar cane; and the report of the station committee of the Hawaiian Sugar Planters' Association for 1906.

The income during the fiscal year ended September 30, 1907, was as follows:

Hawaiian Sugar Planters' Association-----	\$65, 645. 50
Fees -----	8, 444. 30
Total-----	74, 089. 80

This station receives no direct aid from the Federal appropriations.

#### IDAHO.

**Agricultural Experiment Station of the University of Idaho, Moscow.**

Department of the University of Idaho.

H. T. FRENCH, M. S., *Director*.

The work of the Idaho Station is still severely handicapped by the lack of accommodations resulting from the burning of the main building of the university in 1906. The completion of Morrill Hall, the agricultural building, under the active supervision of the director, has provided offices for the director and most of the staff, and a portion of the equipment has been replaced. Laboratories are also available for the chemist and the newly established department of dairying, but the remainder of the building is occupied by other departments of the university, pending the completion of the new administration building. In addition, the forcing houses used for soil fertility tests and the greenhouses for horticultural work in winter have had to be given up, making necessary the suspension of these lines until new buildings in their stead can be completed. Considerable congestion of work has resulted from these causes, and the investigations of the station have in the main been restricted to such as could be carried on in the field.

The station has outlined Adams fund investigations on the factors affecting the gluten content of wheat, and its reputed deterioration under local conditions; the duty of water in summer, winter, and fall irrigation; and the utilization of orchard by-products, especially cider fermentation. There was delay in starting some of these lines of work owing to the destruction of the station laboratories by fire and the fact that the new quarters were not ready.

Investigations in irrigation and dry farming in cooperation with this Office are in progress at the substation at Caldwell for which a State appropriation of \$3,000 has been made for permanent improvements.

Some of the other lines of the work have included studies by the chemist of the ash content of fruit trees with reference to determining the demands of the growing tree upon the soil and its fertilizer requirements, and examinations of by-products of flour mills with reference to their nutritive value. The plant pathologist has tested a number of spraying materials for fungus diseases and insect pests, notably tomato blight, apple scab, and the codling moth. Breeding and cultural tests with tomatoes and breeding work in the crossing of sweet corn were made by the horticulturist, who resigned toward the close of the year.

In agronomy there have been rotation experiments, fertilizer trials with cereals, the growing of various clovers in cooperation with the Bureau of Plant Industry of this Department, variety testing of wheat, etc. In stock feeding a number of rations have been tested with pigs, cows, and calves.

In addition to a number of press bulletins the following publications were received from this station during the fiscal year: Bulletins 54, Picking, packing, and marketing the apple; 55, Mixed sprays for apple scab and codling moth; and 56, The Rex spray and other lime and sulphur compounds; a Special Bulletin, Insecticides and fungicides; and the Annual Report for 1906.

The income of this station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	5,182.04
Balance from previous year, Adams Act.....	1,817.96
Farm products.....	1,533.49
Balance from previous year.....	243.46
<b>Total .....</b>	<b>23,776.95</b>

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

In spite of the difficulties which it has encountered the Idaho Station is accomplishing a considerable amount of useful work. It is hoped that under the improved conditions resulting from the completion of the new equipment it will be possible greatly to strengthen its work in the near future.

#### ILLINOIS.

**Agricultural Experiment Station of the University of Illinois, Urbana.**

Department of the University of Illinois.

EUGENE DAVENPORT, M. Agr., *Director*.

A laboratory of physiological chemistry for the study of problems in animal nutrition has been established at the Illinois Station as a branch of the department of animal husbandry and placed in charge

of Dr. H. S. Grindley. The main line of work thus far undertaken is the study of the wholesomeness and healthfulness of saltpeter in the curing of meats, to which the live-stock interests of Chicago have contributed about \$30,000. Investigations in floriculture have also been begun by the station under a State appropriation of \$7,500 annually for the current biennium.

The station inaugurated four lines of investigation under the Adams fund, namely: A study of the character and cause of the injury to apple trees by spraying materials; the principles relating to the transmission of characters in the apple as affected by selection and crossing; a statistical study of heredity; and an investigation of the effects of inbreeding in plants and animals. Work in each of these lines is well under way and is proceeding in a thorough and systematic manner.

Studies in soil fertility are in progress on twenty-four rented farms about the State as well as at the station. At the latter the depth to which plants feed is being studied by means of deep jars in which the plant food is placed at different depths. In the field, rock phosphate is being compared with bone meal for worn land and a study is being made of the practice of cultivation to determine whether its value lies in the stirring of the soil or the removal of weeds.

The dairyman is continuing his studies on the differences in efficiency of individual cows, and has tested many herds about the State. The milk supply of the larger cities has been a special subject of study. He is also gathering data at a private farm as to the cost of raising heifers, and is determining the value of alfalfa, timothy, and other forage for dairy stock. A model dairy farm of 20 acres has been laid out and provided with a new cottage and a circular barn, the latter so arranged as to diminish labor as far as possible.

In animal husbandry the principal experiments have been in feeding horses a variety of rations in preparation for market, influence of age on cost of beef production, the proper ratio of roughage to concentrates in fattening lambs, and the protein requirements of pigs. The results of much of this work are awaiting publication.

The horticultural and botanical work has included the improvement of fruits by breeding, and variety experiments with melons, tomatoes, onions, and other vegetables. The grading and packing of melons has received considerable attention. A good deal of plant breeding is also in progress, especially with corn, oats, wheat, and clover, and there has been a continuation of the studies of plant diseases.

During the year nine bulletins, nine circulars, and an annual report were received from this station, as follows: Bulletins 107, Comparative experiments with various insecticides for the San José scale;

108, Spraying apples for the plum curculio; 109, The location, construction, and operation of hog houses; 110, Storage barn, sheds, feed lots, and other equipment for feeding experimental cattle in carload lots; 111, Maintenance rations for beef-breeding cows; 112, The cottony maple scale in Illinois; 113, The shrinkage of ear corn in cribs; 114, Spraying for the codling moth; and 115, Soil improvement for the worn hill lands of Illinois; Circulars 102, Testing individual cows; 103, Story of Rose and Queen; 104, Detailed bill of material for storage barn, sheds, feed lots, and other equipment for feeding experimental cattle in carload lots; 105, The duty of chemistry to agriculture; 106, Remarkable difference in dairy cows; 107, Fruit and orchard investigations; 108, Illinois soils in relation to systems of permanent agriculture; 109, Improvement of upland timber soils in Illinois; and 110, Ground limestone for acid soils; and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	7,000.00
State appropriation-----	95,000.00
Fees-----	842.00
Farm products-----	22,604.17
Miscellaneous-----	1,861.57
Total-----	142,307.74

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the Illinois Station is highly appreciated by its constituents, with whom it is in close touch through its widely conducted experiments and inquiries. The results of its investigations and demonstrations are having a pronounced influence on farm practice.

#### INDIANA.

##### *Agricultural Experiment Station of Indiana, Lafayette.*

Department of Purdue University.

ARTHUR GOSS, M. S., A. C., *Director.*

The work of the Indiana Station has continued along much the same lines as formerly, with considerable attention directed to demonstrations and similar features of an extension character carried on about the State, and for which the State has continued its special appropriations. A separate officer has been assigned to this work, but he is assisted by various members of the station staff. Thus, in dairying, records are being kept of about thirty herds as to the cost of feed, milk, and butter production, and approximate profits. Several

butter-scoring contests for creameries and dairies were again held, and an extensive educational exhibit was made at the State fair. The State board of agriculture has granted the station the sole use of a large building on the fair grounds, which has been remodeled, equipped as a working dairy, and provided with an auditorium for lecture purposes. There are corn-breeding plats at fifteen localities in the State, and cooperation with several hundred farmers, chiefly in the testing of cereals and fruits, spraying demonstrations, the renovation of orchards, and field tests of soils and fertilizers.

An extensive cattle-feeding experiment was continued during the year, and a carload lot of short-fed Missouri cattle was exhibited by the station at the International Live Stock Exposition, where it received first prize in its class and attracted much attention from feeders. Various feeds for beef cattle have been compared, and data are being collected from about 3,000 feeders on present practices in the State. In pig feeding, a fifth year of work has been completed on pasturing soy beans in the field, and tankage has been compared with oil meal for fattening. There was also work on the bacon pig, pure-bred versus cross-bred pigs, improvement through the use of Yorkshire blood, and with sheep on the maintenance of ewes.

The dairy department is studying the constituents of butter, especially the water content as shown by determinations in butter made in the college creamery and in that from other creameries and dairies about the State. It has been found difficult to maintain a water content of less than 16 per cent in early spring. The percentage of soft fats also increases at this season, and it has been found that these fats absorb more water when churned. Feeding work is now under way to determine whether the soft fats at this period are due to the period of lactation or to the feed. The department has its own chemical laboratory, and is also studying the coagulation of albumin in milk by heat.

Plant-breeding work at the station has been largely with reference to the improvement of the milling quality of wheat, about 25,000 plants being available, but some work has also been done with other cereals and with horticultural crops. The station has taken over the breeding work begun by the State horticultural society several years ago, and this material is now coming into bearing. Cultural work is in progress with soy beans, drilling, broadcasting, etc., and much attention is being given to melons, especially as to wilt and other diseases which are causing much loss.

The station inaugurated investigations under the Adams Act upon the rusts, hog cholera, the cause and treatment of cornstalk disease, and the relation between composition and productivity of soils. It has been decided to transfer the latter study to State funds and to



substitute for it the investigation of the factors affecting the moisture content of butter.

The revenue and facilities of the station are rapidly increasing. An appropriation of \$100,000 was secured very readily from the last legislature for a new station building. A two story and basement brick structure with 200 feet frontage is now in course of construction, which, when completed, will be one of the largest and finest buildings devoted exclusively to station uses in this country. The legislature also passed a new feeding-stuff control law, the administration of which was intrusted to the station. A tonnage tax of 20 cents is provided for carrying on the work, but it is expected to yield a considerable surplus, which will be available for the general work of the station. The fertilizer and feeding-stuff inspection has been organized as a separate division under the direction of the former deputy State chemist, who has been made State chemist under the supervision of the station, and the inspection force has been increased.

The station has begun the issue of a series of circulars, those received during the fiscal year being as follows: Circulars 1, Hints on preparing for and holding local corn shows; 2, The selection, preservation, and preparation of seed corn; 3, Cornstalk disease; 4, The experiment station building; 5, Report of experimental work on the Randolph County farm; 6, The feeding stuff control law; and 7, Additional information concerning the feeding stuff control law.

Other publications have included Bulletins 113, Characteristics of some of the contagious and infectious stock diseases; 114, Winter wheat; 115, Steer feeding; 116, The hand separator and the gravity systems of creaming; 117, Results of cooperative tests of varieties of corn, wheat, oats, soy beans, and cowpeas; 118, How to control the San José scale and other orchard pests; 119, Indiana plant diseases in 1906; 120, Soy beans, cowpeas, and other forage crops; and 121, Commercial fertilizers; and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	2,000.00
Balance from previous year, Adams Act.....	5,000.00
State appropriation <sup>a</sup> .....	22,916.67
Miscellaneous.....	23,071.91
Balance from previous year.....	2,079.74
Total.....	70,068.32

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The Indiana Station has developed rapidly in the support which it receives from the State, and is organizing its work along broad lines

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<sup>a</sup> For the year ending September 30, 1907.

of usefulness. With this aid and various forms of extension and demonstration work, it has aroused remarkable interest among the farmers of the State. Its activity is characterized by an aggressive attitude and a live appreciation of the practical needs of the people.

#### IOWA.

##### **Iowa Agricultural Experiment Station, Ames.**

Department of Iowa State College of Agriculture and Mechanic Arts.

C. F. CURTISS, M. S. A., *Director.*

The Iowa Station has continued to make progress in the development and organization of its work. During the year the extension work has been given a distinct organization with a separate corps of from eight to ten specialists and under the direction of the former agronomist as superintendent. An appropriation of \$15,000 was secured for this work which has since been increased to \$27,500 and made an annual appropriation. The duties assumed by the extension department include the demonstration work hitherto conducted by the station at the county poor farms, the running of special farming trains, and the holding of short courses away from the college.

A 200-acre farm has been purchased on which a dairy barn has been erected. The new farm is to be used largely for dairy work, but 20 acres have been reserved for poultry husbandry, which will be taken up as a new line of work. A tract of 55 acres particularly adapted to horticulture and forestry has also been acquired, thereby increasing the area of the college farm and grounds to about 1,200 acres. The corner stone of the elaborate four-story agricultural building for the college and station was laid June 6, 1907, by Governor A. B. Cummins, and the construction is well under way.

The station confined its Adams fund projects for the first year to two lines, namely, a thorough investigation upon the subject of humus formation and its relation to soil fertility; and the influence of feed, environment, and breeding of native unimproved cows and their offspring. Good progress was made upon the first project and important data secured during the season. Only preliminary steps were taken toward inaugurating the second project.

The station has under way a variety of feeding and breeding work. Results of tests of tankage and meat meal as supplements to corn in swine feeding have been published, and methods of preparing corn for feeding and rations for brood sows are being studied. Feeding hogs skim milk inoculated with tuberculosis germs has been uniformly found to transmit the disease, and tests are under way to ascertain whether hogs may not also acquire it by following tuberculous stock. With cattle, corn silage is being fed in connection with clover, hay,

and other feeds for beef production, an alfalfa product is being compared with gluten feed, and breeding experiments have been begun with reference to the transmission of color and other characters. Sheep breeding for the production of a combined wool and mutton type for range conditions is in progress, as are also feeding trials with sugar beets (partly as to the formation of renal calculi when fed to breeding rams) and with silage, alfalfa, mangels, and other crops. For horses a ration of corn, oats, and oil meal 12:3:1 has been found an excellent substitute for oats at 80 per cent of the cost. Considerable stock is being imported for horse breeding, a Shire-Clydesdale cross being sought which will make a better draft horse and have a gray color.

Chemical work has included an investigation of commercial feeding stuffs and condimental stock foods, and bulletins have been issued giving the results obtained.

In dairying the studies on the moisture content of creamery butter and its control have been continued. With other conditions uniform, variations of from 12 to 16 per cent were without effect on the keeping quality of the butter even with shipments sent to England or held in storage for six months in New York. A milk starter composed of distilled water and glucose, to which is added 15 per cent of milk, has been devised and used in butter making with good results.

Botanical studies have been made of a mold of corn causing disease of stock, and as to the vitality of weed seeds. A bulletin embodying results of an examination of the clover, alfalfa, and timothy seed offered for sale in the State drew attention to the importance of regulations as to vitality and purity, and led to the enactment of a State law for the purpose.

The horticultural work has been largely in continuation of that of previous years, including experiments on cold storage of apples in cooperation with the Bureau of Plant Industry of this Department, extensive spraying trials, and tests of orchard fruits, hardy ornamentals, and wind-breaks. Experiments have also been taken up to determine the relative durability of different woods for fence posts and the value of a preservative treatment.

Extensive plant breeding work is under way chiefly with corn, but also with winter wheat, oats, and barley. A number of factors affecting the yield and quality of oats are also being studied.

For soil investigations about 23 acres are now in plats at the station besides about 60 acres at six field stations. These stations are located on the more important soil types of the State and are utilized for studies in soil management. A soil sampler has been devised which furnishes a solid core of soil 3 inches in diameter to any depth up to 15 inches.

In agricultural engineering irrigation experiments with sewage water have been continued in cooperation with this Office. The relative economy of alcohol versus gasoline for lighting and farm power has been studied and roller and friction bearings are being compared as to draft in farm vehicles.

Bulletins 86, Investigation of concentrated commercial feed stuffs as sold in Iowa; 87, Condimental stock foods and tonics; 88, The vitality, adulteration, and impurities of clover, alfalfa, and timothy seed for sale in Iowa in 1906; 89, Spraying calendar; and 90, Evergreens for the Iowa planter, were received from this station during the fiscal year.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation .....	35,194.62
Farm products .....	849.19
Miscellaneous, including fees .....	10,292.08
Total .....	68,335.89

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedule prescribed by this Department and has been approved.

The work of the Iowa Station is going forward in an efficient and systematic manner. It has been greatly appreciated in the State and continues to receive good support from that source.

#### KANSAS.

**Kansas Agricultural Experiment Station, Manhattan.**

Department of Kansas State Agricultural College.

C. W. BURKETT, M. S., *Director.*

At the beginning of the year the station council system of management was abolished and responsibility lodged with a new director, with exclusively administrative duties. Evidences of the benefits of this change are to be noted in a number of directions.

The college and station work has been materially augmented by liberal appropriations from the State legislature aggregating over \$600,000 for the ensuing biennium, an amount one-half as large as the entire expenditures of the State for these purposes during the previous forty-four years' history of the college. While a greater part of this amount is for the college work, including over \$200,000 for new buildings, the station will be materially benefited by the increase in facilities and personnel. The veterinary building provided for will be of especial advantage. About \$12,000 is available for farmers' institutes and \$61,000 for the substation at Fort Hays.

A number of other laws were also passed by the legislature which were of interest to the station, notably those providing for the inspection of fertilizers, feeding stuffs, foods, and drugs. The execution of the feeding stuffs and fertilizer laws is intrusted to the director of the station, and the analytical work to the chemist. A tonnage tax is authorized which is expected to yield a considerable income in excess of expenses. In the case of the food and drugs act, the inspection is under control of the State board of health, but the chemists of the agricultural college and the State university perform gratuitously the analytical work.

Another act which was passed authorizes the board of county commissioners of any county in which a substation has been or shall be established by the board of regents of the college, to purchase, on the petition of one-half of the legal voters of the county, a tract of land not exceeding 320 acres and at a cost of not over \$5,000 for lease or donation for experimental purposes, and to levy a tax in payment. The legislature also designated the college as the State highway commission, and it is authorized, in addition to other duties, to conduct demonstrations in road building. An appropriation of \$2,500 was also made for the importation of promising strains of wheat, and the director visited Turkey and southern Russia for this purpose during the summer of 1907.

Under the Adams Act the station inaugurated an important series of studies on fundamental factors and principles relating to the breeding of wheat and the correlation of characters; "cerebritis" in horses; hog cholera; the digestibility and nutritive value of certain local-grown feeds; and chemical and milling studies of Kansas hard wheats. Work was started on most of these projects during the year.

In addition to these projects, considerable experimental work is in progress under other funds. In agronomy this has centered mainly around (1) the production and distribution of improved seed, especially wheat and corn, but also including barley, oats, Kafir corn, and sorghum; (2) rotations in which either corn or wheat is the central crop, and (3) tests of varieties, fertilizers, and cultural methods of various crops, with control observations on soil moisture and temperature. Much of this work, especially that of seed improvement, is in cooperation with farmers and a part is conducted at the Fort Hays substation.

The dairy work includes feeding experiments with milch cows, studies in cheese ripening and butter making under different conditions, creamery construction and the disposal of dairy sewage, and experiments in milking machines. The dairy husbandman also has charge of experiments in breeding, feeding, and rearing poultry.

Horticultural work has followed the general lines of previous years, including mainly a study of vegetables for canning, the maximum

productive capacity of small areas in garden truck, spraying for insects and diseases, the improvement of native fruits, and fertilizers for strawberries. The horticulturist has also continued observations on forest and ornamental plants and has tested the use of oil in road making.

The botanist has carried on breeding work with corn, oats, and alfalfa, and has made a very thorough study of the quality of the seeds sold in the State, more particularly the alfalfa, brome grass, and English and Kentucky blue grasses. Other miscellaneous lines of the station have been the nursery inspection, general observations on the occurrence of San José scale and green bugs, and some work in crossing hogs and feeding beef cattle.

The increased appropriation for the Fort Hays substation has made possible the reorganization of that work on a much more comprehensive and thorough scale. Material additions were made to the force and equipment, and there was considerable progress in systematizing the experimental work which now includes a variety of trials in agronomy, horticulture, forestry and animal husbandry under both dry farming and irrigated conditions. A large amount of excellent land watered by a perennial stream is available for the use of the substation, and a considerable area is set apart for experiments in dry farming in cooperation with the Bureau of Plant Industry of this Department.

There has been considerable activity in extension lines, in which most of the station staff participated. Over 100 farmers' institutes were held and there were a number of seed corn, dairy, and alfalfa trains, boys' corn judging contests, and the like. It is estimated that in these various ways more than 60,000 people in the State were brought into direct touch with the station.

The following publications were received from this station during the year: Bulletins 136, Press bulletins Nos. 125-151; 137, Variations in the test of separator cream; 138, Effect of bacteria in wash water of butter; 139, The study of corn; 140, Milking machines; 141, The inspection of seeds and the Kentucky pure-seed law; 142, The value of oil in road improvement; and 143, Disposal of dairy and farm sewage, and water supply; Special Circular No. 21, Pure versus poor seed; and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation and other receipts for substation..	19,267.46
Fees .....	3,170.00
Farm products .....	7,272.68
Miscellaneous .....	752.64
Total.....	52,462.78

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The Kansas Station made marked progress during the year in establishing more efficient organization and in extending the scope and raising the grade of its experimental work. The year was also marked by the inauguration of a more just and liberal policy with regard to State appropriations for the support of the work of the station and salaries of its officials.

#### KENTUCKY.

*Kentucky Agricultural Experiment Station, Lexington.*

Department of the Agricultural and Mechanical College of Kentucky.

M. A. SCOVELL, M. S., Ph. D., *Director.*

The Kentucky Station has continued to improve its equipment of land, buildings, laboratory facilities, and live stock. A tract of about 40 acres, with buildings, was acquired during the year and is being put in shape for experiments in dry-lot, grazing, and soiling work with swine. The completion of the new greenhouse will materially improve the facilities for scientific work in botany and chemistry.

The station has five projects under the Adams fund as follows: Soil investigations, especially as related to the determination of manurial requirements; a bacterial disease of growing tobacco; the corn-ear worm; the nodule organism of alfalfa and its relation to those of sweet and red clover; and contagious abortion in horses. Although work on several of these was not started until late in the season considerable progress has been made.

The general lines of work have remained much as in previous years. The duties in connection with the various State inspections, which now cover foods, fertilizers, feeding stuffs, nursery stock, and seeds, continue to increase but are so arranged as to interfere very little with other station work. The fees yield nearly \$50,000 of revenue, much of which is available for maintenance, thereby materially supplementing the experimental work under the Federal funds.

The chemist is cooperating with the geologist of the college in a geological survey of the State, and with the botanist in a study of the influence of inoculation on the nitrogen content of legumes. He has also studied the composition of soils under sour dock, the weathering of fodder, and the protein content of corn and wheat in breeding experiments. In connection with the soil work, it has been discovered that a remarkable deposit of phosphates exists in the subsoil of the station farm, and that the percentages vary in a striking way at different depths in the soil, some samples containing as high as 15 per

cent of phosphoric acid. This indicates the formation of the soil by the decomposition of phosphate in place.

The botanist and entomologist is carrying on extensive rotation experiments in cooperation with the Bureau of Plant Industry of this Department, comparing various grasses and forage plants, improving soy beans, spraying orchards on a private farm, and making cooperative tests of varieties of wheat in different parts of the wheat section of the State. A study of the food of the crow blackbird has shown this bird to be a valuable ally of the farmer and worthy of protection. Some attention has been given to tobacco breeding, and, as formerly, investigations in curing are a prominent feature. One



FIG. 2.—Experimental tobacco-curing barn, Kentucky Station

season's study of the influence of temperature, humidity, ventilation, and other factors on the curing of tobacco in a specially constructed experimental curing house (fig. 2) has been completed and the results are awaiting publication.

In animal husbandry there has been feeding and breeding work with pigs and the breeding of Jersey cattle for external conformation and appearance and butter-producing capacity. As a result of this work the Jersey herd has been much improved in quality and value from the show-ring and butter-producing standpoints.

The publications of this station received during the year were Bulletins 127, The inspection of seeds under the Kentucky pure-seed



law; 128, Analyses of commercial fertilizers; and 129, Tobacco; and the Annual Reports for 1903, 1904, and 1905.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	7,000.00
Fees -----	48,791.27
Farm products -----	6,905.14
Miscellaneous -----	297.52
Balance from previous year-----	1,016.84
Total -----	79,010.77

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The Kentucky Station now has excellent equipment and quite liberal means for experimental work, and is making creditable progress in raising the scientific plane and extending the scope and practical application of its work.

#### LOUISIANA.

- No. 1. Sugar Experiment Station, Audubon Park, New Orleans.
- No. 2. State Experiment Station, Baton Rouge.
- No. 3. North Louisiana Experiment Station, Calhoun.

Department of Louisiana State University and Agricultural and Mechanical College.

W. R. DODSON, A. B., B. S., *Director, Baton Rouge.*

The work of the Louisiana stations has continued to prosper. Few changes in personnel have taken place, and at each station there has been a consistent development of the scope and scientific aspects of the work.

At Audubon Park interest has centered chiefly around problems connected with the growing of sugar cane and the manufacture of sugar, but some attention has also been given to forage crops, fiber investigations, and fruits and vegetables. Some important studies have been inaugurated, in part under the Adams Act, on the sugars and nonsugars occurring in sugar cane and as to the effect of sulphur dioxide in bleaching cane juice and the changes occurring in the sulphur compounds remaining in the products. A study of the effect of Louisiana sirups on the human system was carried on with negroes in which molasses containing as much as 900 milligrams of sulphur as sulphites per kilogram was consumed without apparent injury. In the work of cane improvement the station, with the assistance of the New Orleans Park Commission, has succeeded in producing over

100 seedling canes from seed received from the Tropics, some of which have made remarkable growth. A considerable number of types and varieties of cane are being grown to test their yield, purity of juice, and other characteristics, and one variety introduced and tested by the station has proved so well adapted to local conditions that it is now planted to a greater extent throughout the State than all other varieties combined. Experiments are also being carried on to test the value of different parts of the cane stalk and of first and second ratoon crops for general planting.

At Baton Rouge the lines of work are much as in former years. The chemist, in addition to inspection duties, is studying the effect of sunshine, dew, and rain during the curing process on the nutrients of hay, especially on *Lespedeza* and native grass hays. Feeding trials are in progress as to the comparative value of oats, rape, and sweet potatoes as hog pastures, the cost of beef production on various feeds, and the value of various crops for silage. Among the results from breeding, fertilizer, and culture experiments with a variety of field crops may be mentioned a discovery that the failure of sorghum, Kafir corn, and similar crops to mature seed may be caused by the presence of a small fly which deposits its eggs in the immature seed and prevents its development. By bagging the tops with cheese cloth to exclude these flies a good setting of seed may be obtained. Field work is being carried on with more than 100 varieties of rice and on an extensive scale with fruits and vegetables. Among other lines an attempt is being made to propagate a variety of oak that appears to be resistant to mistletoe.

The Adams fund investigations at Baton Rouge relate to smut diseases of the rice plant; wilt disease of the pepper; soft rot of cotton; root disease of sugar cane; vaccination against anthrax; infectious cerebro-spinal meningitis in horses and mules; "foot evil" of the horse; and an undescribed disease of small chicks. A number of these matters are of special local importance and the investigations are of a substantial character. In connection with the anthrax work results have been published of a study of horse flies as a possible means of spreading the disease.

An effort is being made to give the work at Calhoun a more scientific trend and, in addition to demonstrations, experiments are being made on the value and cost of irrigation for truck crops, together with fertilizer trials with corn, oats, and cotton, the Williamson method of corn culture, corn planting by individual ears, and miscellaneous work with forage crops. In a study of the influence of different fertilizers on the taste and quality of cane sirup, variations were noted in different plats which amounted to as much as 7 cents per gallon when graded by experts from the New Orleans Exchange. A collec-

tion of seedling peaches and native plums and grapes has been started as a foundation for future breeding and selection work.

As in former years, there is a good deal of work in cooperation with this Department, especially the Bureau of Plant Industry, in the fiber investigations, rice culture at Crowley (fig. 3), and in the introduction of promising citrus fruits and grasses. Herd testing and feeding work has been carried on at Hammond in cooperation with the Bureau of Animal Industry and with the assistance of this Bureau and the State Crop Pest Commission two parishes in northern Louisiana have been nearly freed from the cattle tick. Tests of creosote as a preservative of fence posts and of the loblolly pine for fence posts, shingles, and other farm purposes were recently begun



FIG. 3.—Fertilizer experiments with rice, Louisiana stations cooperating with United States Department of Agriculture.

in cooperation with the Forest Service. Through the State geological survey, which is still in charge of the director of the stations, there is also cooperation with the United States Geological Survey and the Coast and Geodetic Survey.

The university now has an enrollment of 600, of whom 150 are in agricultural courses. A school of agriculture has recently been established on lines very similar to that at the University of Minnesota. A new chemical laboratory is being built with special facilities for industrial lines. Laboratories are to be provided for agricultural analyses and the chemistry of sugar, cotton, rice, and petroleum and their by-products. It is claimed that when completed the laboratory as a whole will rank among the largest and best equipped in the

South and that the sugar laboratory will be the most complete of its class in the world.

The publications of the stations received during the fiscal year included Bulletins 86, Our available stock foods; 87, Analyses of commercial fertilizers and Paris green; 88, Analyses of commercial feeding stuffs; 89, Nodule disease of the intestines of sheep; 90, Summary of results with vegetables and fruits at the North Louisiana Experiment Station from 1892 to 1907; 91, The chemistry of the sugar cane and its products in Louisiana; and 92, Experiments in the late planting of cotton to avoid boll weevil damage during 1906; and the Annual Report for 1906.

Owing to a misunderstanding as to the provisions of the Adams Act, the State appropriation to the stations was reduced from \$15,000 to \$10,000, but this was counterbalanced in part by the increased income from funds derived from inspection of fertilizers and feeding stuffs.

The income of the stations during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation.....	10,000.00
Balance from previous year.....	7,001.13
Fertilizer fund .....	9,300.00
Farm products .....	7,191.18
Total.....	55,492.31

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the Louisiana stations has shown considerable development and extension along scientific lines and the results of the investigations, as they are becoming known by the people throughout the State, are highly appreciated.

#### MAINE.

**Maine Agricultural Experiment Station, Orono.**

Department of the University of Maine.

C. D. WOODS, Sc. D., *Director*.

The work of the Maine Station has been largely a continuation of previous lines. During the year the station prosecuted investigations under the Adams fund upon the early blight of potatoes; the physiology, life history, and morphology of the potato-scab fungus; and investigations on the nutritive value of corn for human food, including a study of the metabolized products. Several projects were outlined by the horticulturist, but these were interrupted before much

progress had been made by the removal of that officer to another institution. Important investigations upon breeding and heredity were substituted at the close of the year, and Raymond Pearl, Ph. D., and F. M. Surface, Ph. D., of the University of Pennsylvania, were appointed biologist and associate biologist, respectively, for research along these lines. Special attention is to be given to an investigation of the principles of inheritance in poultry, the practical phases of which have already been extensively developed. About 600 hens are now kept for breeding stock, the standard of production required being 160 eggs per year. Medium and large flocks on equal floor space have been compared, and breeding work has been begun to determine the extent of transmission of good laying qualities. Digestion experiments with poultry are being made chiefly as a study of methods.

In connection with the poultry investigations a laboratory has recently been built for use in the experimental work in breeding. The building has been designed with special reference to surgical work, and consists of a preparation room and general laboratory, a sterilizing room, and an operating room, arranged in a series. For the better maintenance of aseptic conditions the walls and ceilings are heavily coated with white enamel throughout, and all sharp angles and projections have been avoided in the construction.

Investigations on the nutrition of man were continued in cooperation with this Office with reference to corn products. White corn milled in the old-fashioned way was compared as to digestibility with granulated meal made from yellow corn, and there was also a study of hulled corn. A bulletin on Indian corn was issued during the year.

Much of the work of the station has centered around potato growing. In addition to the Adams-fund projects, field work included trials of home-mixed fertilizers, and comparisons of dry Bordeaux and Sal Bordeaux with liquid Bordeaux mixture. The entomological work also was chiefly with reference to potato insects and plant lice on potatoes.

The State inspection work is becoming increasingly heavy, the analyses of foods, fertilizers, and feeding stuffs requiring nearly all the time of the chemists. A seed inspection has also been made, and a new botanical laboratory has been fitted up.

At the last session of the legislature the university received an appropriation of \$130,000 for maintenance during the ensuing biennium, besides \$90,000 for a new agricultural building and a central heating plant. A protracted contest to compel the abolition of the B. A. degree was unsuccessful.

Arrangements were made by the university to establish a forestry experiment station in cooperation with the Forest Service of this Department, the university providing 5 acres of land and exercising

immediate supervision of the experimental work, which is to be in charge of the college forester. The object sought will be to determine the species and cultural methods best suited to Maine conditions.

An increasing amount of attention is being given by the university to extension work, especially demonstrations. Afternoon meetings were held during the summer at a number of farms, the programme including a talk and demonstration on milk testing, spraying, pruning and grafting, soil fertility, home mixing of fertilizers, and other topics.

The publications received from the station during the year were as follows: Bulletins 130, Poultry experiments; 131, Indian corn as food for man; 132, Plant breeding in relation to American pomology; 133 and 140, Fertilizer inspection; 135 and 136, Food inspection; 138, Seed inspection; 139, Orchard notes, 1906; 141, The prevention of potato scab; and 142, Feeding stuff inspection.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
Inspectors' fees, sales, etc.....	11,277.68
Balance from previous year.....	3,685.84
Total.....	36,963.52

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the Maine Station has been strengthened by the important biological studies it has undertaken in connection with the breeding of poultry, and also its investigations of potato diseases both in the laboratory and in the field.

#### MARYLAND.

**Maryland Agricultural Experiment Station, College Park.**

Department of Maryland Agricultural College.

H. J. PATTERSON, B. S., *Director*.

With the aid of increased State and Federal appropriations the Maryland Station has improved its equipment and strengthened its work in many important particulars. A new horticultural building with greatly enlarged greenhouse capacity (fig. 4) and a dairy barn (fig. 5) especially adapted to experimental work are in course of construction. A poultry department has been established and a poultry plant has been built and partly equipped.

The station outlined two main lines of investigation under the Adams Act, one upon certain problems relating to city milk supply

and the other a study of the life history of several greenhouse insect pests and the apple-tree leaf miner. A portion of the work under the latter head was completed during the year.



FIG. 4.—Greenhouse and horticultural laboratory, Maryland Station.

In agronomy attention was given mainly to variety testing and to the breeding of corn, wheat, cowpeas, clover, and alfalfa, much of the work being in cooperation with the Bureau of Plant Industry of this Department. There is also cooperation with this Department



FIG. 5.—New dairy barn, Maryland Station.

in tobacco investigations and in studies of preventives for the peach-tree borer and of the effects of different crop rotations on the maintenance of soil fertility. Considerable work is also in progress in different parts of the State in cooperation with farmers. The agron-

omist has recently resigned to accept the associate professorship of agronomy in Ohio State University.

In horticulture the chief lines of work have included the continuous culture of sweet potatoes; fertilizer experiments with asparagus, cabbage, and other vegetables, with fruits and with chrysanthemums, carnations, violets, and primulas; variety tests of fruits, flowers, and vegetables; tests of various greenhouse methods and practices; breeding of apples, pears, and strawberries; studies as to the possibilities for Persian walnut culture in Maryland, as to the introduction and improvement of the pawpaw, the effect of copper sulphate on immunity to disease and on the life of apple pollen; mushroom culture; and a number of minor subjects.

As in previous years, State inspection work has occupied much of the time of the botanist and entomologist. In addition, the work of the entomological department has included studies of the life history, habits, and means of treatment of the peach scale, scurfy scale, and codling moth; tests of various spray solutions for the San José scale; experiments on fumigation of nursery trees with hydrocyanic-acid gas; trials of various strengths of the gas on peach buds, and experiments with different materials for the control of the woolly aphis in nurseries. Tests of different mixtures and devices as preventives for the peach-tree borer were carried on in cooperation with the Bureau of Entomology of this Department. An innovation was the operation by the station in a number of small towns of a spraying apparatus to ascertain the feasibility of public ownership of such apparatus. It was found that with proper management an outfit of this sort could be made self-supporting without excessive charges, and could be of material assistance to owners of small orchards and others with but little work to be done.

Other station activities have included studies of bovo-vaccination as a means of immunizing against tuberculosis and observations on leucoencephalitis by the veterinarian, some studies of weeds and means of their eradication and of diseases of alfalfa and clover by the botanist, and on the flavors of milk and the conditions which influence their development by the dairyman. In addition to incidental work, the chemist has continued the studies of the sugar content of sweet corn grown under different conditions in cooperation with the Bureau of Chemistry of this Department.

The poultry work has been mainly of a preliminary nature, but it is planned to include comparisons of different types of poultry houses, the breeding of Barred Plymouth Rocks for egg production, and studies of causes of mortality of incubator chicks and of rations for egg production.

During the fiscal year eight bulletins and two annual reports were received from this station as follows: Bulletin 109, The mos...



110, Results of experiments on the liming of soils; 111, The oyster-shell scale; 112, Treating San José scale; 113, Tomato investigations; 114, Fertilizer experiments with different sources of phosphoric acid; 115, Control of insect pests and diseases of Maryland crops; and 116, Marketing fruit and truck crops; and the Annual Reports for 1905 and 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15, 000. 00
United States appropriation, Adams Act.....	6, 763. 89
Balance from previous year, Adams Act.....	236. 11
State appropriation .....	18, 303. 17
Farm products.....	6, 365. 63
Total.....	46, 668. 80

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

Although handicapped by a number of changes in its personnel, the Maryland Station is successfully developing its work along many important lines, and is winning in increased measure the confidence of the farmers of the State, as is evidenced by increased support and wider use of the results of its investigations.

#### MASSACHUSETTS.

**Massachusetts Agricultural Experiment Station, Amherst.**

Department of the Massachusetts Agricultural College.

W. P. BROOKS, Ph. D., *Director.*

In order to secure uniformity in nomenclature with other stations the name of this station has been changed from the Hatch Experiment Station of the Massachusetts Agricultural College to Massachusetts Agricultural Experiment Station. Upon the retirement at the close of the year of Dr. C. A. Goessmann, who has had charge of the instruction and experimental work in chemistry practically since the establishment of the college, the chemical work of the station was reorganized as a department of plant and animal chemistry, under the direction of Dr. J. B. Lindsey, and with divisions of research work, fertilizer control, and feeds and dairying. R. D. McLaurin, Ph. D., of the Rockefeller Institute, has been added to the staff in the research division and numerous minor changes in personnel have taken place.

The Adams-fund projects of the station deal with rust-resistant types of asparagus and the principles underlying fertilizing the crop; a study of injurious and beneficial insects affecting the cran-

berry; descriptions and life histories of insects belonging to the groups of *Pyralidæ* and *Tortricidæ*; effect of Porto Rico molasses on digestibility of hay; specific effect of oil of soy bean on the composition of milk, on milk fat, and on the consistency of butter; and a study of the principles underlying the use of fertilizers for the cranberry crop. The funds did not prove adequate to inaugurate work in all of these lines, but good progress was made on several of the projects.

Aside from these new lines, the work of the station has remained much as in former years. In horticulture, special attention has been given to pruning experiments with orchard trees, a study of the influence of the stock on the scion, experiments with dwarf fruit trees, and some work in breeding with a view to testing certain factors in Mendel's and Galton's laws.

The entomologists have continued experiments on the resistance of plants to fumigation with hydrocyanic-acid gas to determine the best dates for spraying for the oyster-shell scale, scurfy scale, and the white-pine scale. The life histories of a number of insects have been worked out and various methods have been tested for repressing the root maggot. Trials are also under way to determine the value of a number of commercial by-products as sprays for San José scale.

A department of veterinary science was added at the beginning of the year in charge of the college veterinarian. Outbreaks of a number of diseases of live stock and poultry have been investigated, notably gastric strongylosis of sheep and goats, and a study has been begun of the effects upon live stock of lead and arsenic in amounts such as might adhere to forage growing under trees which have been sprayed.

The botanical department has devised a very effective apparatus for purifying seeds, and has shown that great benefits may be obtained by treating commercial samples in this way. As a result of this work several hundred pounds annually of onion, lettuce, and other seeds are sent to the station for treatment.

The dedication of Clark Hall, the new botanical building erected at a cost of about \$50,000, occurred in October, 1907, in connection with the observance of the fortieth anniversary of the opening of the college to students.

The anniversary exercises on this occasion took the novel form of a conference on rural progress, participated in by representatives of various educational, religious, and social interests, as well as those distinctly agricultural, and proved of much value in bringing the work of the institution before the general public. Another notable event of the year tending toward the same end was the holding of a summer school of agriculture for teachers. This was even more successful than anticipated, the enrollment exceeding 200 students.

The publications of this station received during the fiscal year were as follows: Bulletins 110, Market milk; 111, Analyses of fertilizers; 112, The examination of cattle and poultry foods; 113, Analyses of fertilizers; 114, The oriental moth, a recent importation; 115, Preliminary report on cranberry insects; and 116, The San José scale and experiments for its control; Technical Bulletin 3, The blossom-end rot of tomatoes; Meteorological Bulletins 210-221; and the Annual Report for 1905.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation.....	16,500.00
Fees .....	4,745.00
Farm products.....	1,267.21
Miscellaneous .....	6,800.42
Total .....	51,312.63

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The Massachusetts Station is passing through a period of reorganization and development. Its material equipment has been considerably improved and its work has been broadened. A beginning has also been made of increased specialization in the work of its staff, and it is believed that this may be carried still further with good results.

#### MICHIGAN.

**Experiment Station of Michigan State Agricultural College, East Lansing.<sup>a</sup>**

Department of Michigan State Agricultural College.

C. D. SMITH, M. S., *Director*.

A number of changes were made during the year which affected the station's work. The entomological department was separated from the department of zoology of the college and the entomologist made an independent station officer. A greenhouse was completed by the college, part of which will be used as an insectary by the entomologist and the rest for the pot-culture work of the chemist. The veterinarian retired at the close of the year. A successor has been appointed, and it is planned under his direction to prosecute the work of that department more actively. The addition of a subdepartment of rural engineering to the agricultural department of the college has made possible some investigations along engineering lines. A bulletin reporting work regarding the use of lightning rods has been recently issued. The barns of the college and station have been moved to a

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<sup>a</sup> Freight and express address, *Lansing*.

new location, and the buildings and yards considerably improved. Plans are being made for a new agricultural building for the college in which the station will share.

The station inaugurated five projects under the Adams fund, namely: Investigations on the bacteriological factors influencing the keeping quality of milk and butter; study of the action of bacteria in rendering available the insoluble elements of the soil; study of utilization of untreated rock phosphate by Michigan soils; the nature and etiology of outbreaks of hog diseases in the State; and an investigation of the so-called "Grand Traverse" disease of cattle. Work has been conducted upon all five projects, but more actively in the case of some than others. A large amount of work has been in progress on the first project, which has involved the heaviest amount of expense. The work upon the last project has been very successful in revealing the nature of the disease and is nearly completed. Its results are of very great importance to a considerable section of the State where it was an epidemic.

In the entomological department studies in cooperation with the Bureau of Entomology of this Department have been made of the larch sawfly, which is estimated to have caused a million dollars' damage in the upper peninsula, and have led to the discovery by the entomologist of a fungus disease which is being developed and distributed. Attention has also been given to the grain thrips and to nematodes in beet fields, together with much work of a miscellaneous character.

The horticultural department is continuing plant breeding and pollination work on a large scale with pears, strawberries, tomatoes, and potatoes. The results of five years' work on pollination of pears in Michigan and elsewhere are ready for publication. Strawberries are being bred especially for lateness and to determine the value of pedigreed plants, minute individual records being made during the last year of 10,000 plants selected for productiveness, lateness, and other qualities. About 10,000 potato seedlings were selected with reference to blight resistance, and some 300 varieties which are especially resistant are being selected within the variety by individual plants. It is expected that the data collected in this work will bear upon the scientific aspects of breeding. Sterilization has been discovered to be a remedy for the rot in head lettuce which was causing the abandonment of lettuce growing in Grand Rapids, and the practice has now been generally adopted.

A study of the essentials of corn breeding by the agronomist indicates that the kernel rather than the ear is the proper unit, that nubbins from high yielding ears give better seed corn than perfect ears from low-yielding mothers, and that productiveness is not invariably inherited. Other breeding work has been carried on with white and

soy beans, flax, alfalfa, barley, and oats, and there has been a continuation of the rotation and fertilizer trials. Soils are being studied which have become "sick" from the continuous growth of peppermint, and the chemist is studying the effect of high and low land and environmental conditions on the elaboration of peppermint oil and related questions.

In animal husbandry a poultry department for which the legislature appropriated \$6,000 has been organized and well established. Experiments in pail feeding versus suckling calves have given a large amount of data as to the relative cost, showing pail feeding to be much the cheaper. With sheep the effect of feed, especially of succulents, on fecundity, has been studied and some breeding work done. An outbreak of cholera during the winter seriously interfered with the work with hogs, which was mainly for the production of an economical bacon type. Both feeding and breeding work was carried on with cattle, the former including trials of dried beet pulp for fattening steers and of root crops as a supplement to silage for dairy cows, and the latter having special reference to types of cattle and the effect of using imported sires on grade and scrub stock.

The substations at South Haven and in the upper peninsula have been steadily developed, much of the work being in the nature of demonstrations. In addition to these there has again been much cooperation with farmers, of which spraying for grapes, apples, pears, and other crops was unusually successful. On some private vineyards spraying for black rot resulted in yields ten times as large as on areas not sprayed. There were also cooperative fertilizer trials of corn breeding and work in the improvement of orchards.

The publications of this station received during the fiscal year were as follows: Bulletins No. 238, First annual report of grade dairy herd; 239, Fertilizer analyses; 240, Roots supplementary to silage for dairy cows; 241, A plan for the improvement of Michigan cattle; 242, Feeding whole grain; 243, Cull beans as a food for swine; 244, Insects new or unusual in Michigan; and 245, Poultry raising; Special Bulletins 36, Spraying calendar, and 37, Spraying; and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000. 00
United States appropriation, Adams Act.....	3,691. 60
Balance from previous year, Adams Act.....	3,308. 40
State appropriation.....	21,350. 00
Fees.....	2,840. 00
Farm products, including substations.....	3,358. 84
Balance from previous year.....	4,130. 01
Total .....	53,678. 85

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The Michigan Agricultural College celebrated its fiftieth anniversary in May, 1907, the occasion attracting much public attention to the institution, in which the station shared. In recent years the experiment station has been an important factor in the activity of the institution and has contributed greatly to its influence upon the agriculture of the State.

#### MINNESOTA.

**Agricultural Experiment Station of the University of Minnesota, St. Anthony Park, St. Paul.**

Department of the University of Minnesota.

E. W. RANDALL, *Director*.

A change in the directorship of the Minnesota Station occurred during the year, Dean Liggett resigning on account of ill health and being succeeded by the present incumbent, who was formerly a member of the board of regents. A department of animal nutrition has been established, in charge of T. L. Haecker as professor of dairying and animal nutrition. The general facilities and personnel of most of the departments have been increased. State appropriations have been made of \$15,000 for a dairy barn, \$7,000 for repairs on the dairy building, and \$16,000 for a farm for use in breeding work with fruits.

The station has seven projects under the Adams Act, as follows: Influence of breeding and feeding upon the character and value of meat; influence of methods of farming upon the fertility of characteristic soil types; investigation of the cabbage maggot with a view to devising better ways of controlling its ravages; principles of stable ventilation; breeding experiments with certain fruits; cereal breeding, including comparison of results of selection and of hybridization; and food requirements for milk production. It is evident that several of these projects are quite large ones, and that more work has been outlined than can be conducted with the Adams fund proper. That fund is being supplemented to considerable extent by other funds.

A study of swamp fever, a supposedly infectious disease of horses, has been begun by the veterinary department in cooperation with the Bureau of Animal Industry of this Department. Much attention has been given to studies of tuberculosis, both as to the mode of dissemination among farm animals and as to the value of Von Behring's vaccines, with which demonstrations have been made with about 85 calves in different parts of the State. Carbolic acid in large internal

The station has the following projects in progress under the Adams fund: Systematic and biological study of scale insects of the State and of several other economic insects; investigation of the milking machine as related to the efficiency of milking, the health of the cows, and milk hygiene; and investigations upon the breeding of mules. Work upon all of these projects was actively begun during the year.

For mule-breeding work 26 mares have been acquired representing thoroughbred, standard and saddle bred, Clydesdale, and other breeds, so that 50 mares and colts are now available. It is also the intention to purchase some jennets and study the reciprocal hybrids.

The biologist is studying household insects and means for their repression, meal and flour beetles, the persimmon-tree borer, corn and cotton insects, and the southern grass worm (*Laphygma frugiperda*), which has become very troublesome to alfalfa, besides a comparative trial of insecticides for controlling the San José scale. An assistant in biology has recently been added to the staff.

Poultry breeding is receiving an increasing amount of attention, and considerable additional equipment has been provided, including a brooder house. An effort is being made to develop a strain of pedigreed laying stock by selection from about a dozen varieties by means of trap nests on the basis of age, egg production, and other factors. The different breeds are also being compared as to the cost of "broiler" production, and similar work is under way with turkeys.

In agronomy 26 plats of one-tenth acre each have been laid off, which are being used for rotations with the crops grown in the South at present and for trials of a number of others believed to be adapted to the region. Several varieties of soy beans have been introduced and grown with success. Cultural and variety tests are being carried on with alfalfa, cowpeas, corn, and cotton, and there is some work in the selection and hybridization of cotton and in the fertilization of cotton, cowpeas, and corn. About 100 acres have been seeded to alfalfa, the valley lands on the farm have been more thoroughly drained, and the pastures have been put into better condition.

In horticulture a rather extensive area is being planted to orchard fruits, shrubs, and vines, both for variety testing and for the study of methods of planting, pruning, and training. Breeding experiments to secure varieties more resistant to disease and of better shipping and market quality are being conducted, and some very successful work has been carried on in propagating pecans. Forest nurseries have been started and some attention given to ornamental shrubs for southern planting. With truck crops the principal work has been in testing varieties of Irish potatoes, methods for securing a second crop, and the fall planting of cabbage seed in the field.

The substations at McNeill, Delta, and Holly Springs continue to be of much service. Some useful studies of fertilizers have been com-

pleted at McNeill, and attention is also being given to sugar cane, sweet potatoes, chufas, strawberries, asparagus, corn, cotton, and rotation crops, and to the manufacture of a high-grade sirup. The Delta substation has made some interesting demonstrations of the possibilities of pig feeding on pasture, and of soil improvement by drainage, fertilizers, and growing of leguminous crops. A yield of nearly 100 bales of cotton was secured from a tract of about 90 acres by farm practices readily available to all growers of the region. At Holly Springs progress continues in the reclamation of the badly worn and washed soils characteristic of the district. These substations are proving very popular in their respective localities and are well supported by the State. For the current biennium \$31,000 was appropriated for their maintenance, besides \$16,000 for buildings and land at Delta and Holly Springs. Considerable sums are also available from the sale of farm products.

During the fiscal year six bulletins and the Annual Report for 1905 were received from the Mississippi Station. The subjects of the bulletins were as follows: Bulletins 94, Report of work at McNeill branch experiment station for 1905; 95, The dairy cow; 96, Insects and diseases liable to be introduced into Mississippi; 97, Inspection and analyses of commercial fertilizers on sale in the State; 98, Varieties of cotton, 1905 and 1906; and 100, Farmers' institute bulletin, 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation for substations.....	37,000.00
Farm products, including substations.....	5,748.46
Total.....	64,748.46

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

#### MISSOURI.

##### Missouri Agricultural College Experiment Station, *Columbia*.

Department of the College of Agriculture and Mechanic Arts of the University of Missouri.

H. J. WATERS, B. S. A., *Director*.

The principal lines which the Missouri Station has developed during the year are animal nutrition, dairying, agronomy, including a soil survey of the State and a study of the fertilizer requirements and crop adaptations of the soil types surveyed, and studies relating to plant physiology. Increased State appropriations, the Adams fund, and cooperation with this Department have made possible an enlargement of the staff and equipment and the extension of the work. A



greenhouse for the botanical building has been completed, and a small veterinary building has been provided on an isolated farm for experiments with animal diseases. A dairy laboratory has been equipped, and many minor improvements have been made chiefly for convenience in handling live stock. An appropriation of \$100,000 was made by the last legislature for a new agricultural building for the administrative, animal husbandry, agricultural chemistry, agronomy and soil survey work of the station and the college of agriculture of the university. A pure-food law was also passed, the analytical work in connection with which devolves upon the station.

The station has nine projects supported in part or whole by the Adams fund. These relate to studies of the use made of food by steers at different ages and in different conditions; relation of the mineral constituents of the ration to nutrition; influence of nutrition of heifers during their growing period upon their subsequent functional activities; breeding peaches for increased hardiness; the dormant period of fruit trees; nutrition of bearing apple trees in its relation to disease resistance of the fruit; factors affecting the chemical and physical properties of milk; immunizing cattle against tuberculosis; and immunizing hogs against cholera and swine plague. A large amount of work has been started on these projects and the plans contemplate thorough and systematic studies in the several lines. Several of the projects are supported to quite a large extent from State funds. The investigation upon the factors influencing the chemical and physical properties of milk is carried on with the cooperation of the Dairy Division of this Department, and includes representatives of several different breeds of animals.

In addition to these projects, the extensive pasturing experiments with steers which have been in progress for several years were continued with eight lots of animals. The question of the best methods of producing baby beef and the economy of supplemental feeds and related questions are being studied very thoroughly. The station is preparing to undertake experiments in breeding cavalry horses and is gradually acquiring stock for the purpose.

Work in dairying has included an extensive comparison of cow-peas, clover, and timothy as roughage for dairy cows, and studies of the causes of variation in efficiency of different separators, the nature and cause of bitter cheese, and a new organism producing ropy milk.

The veterinarian has made some studies relating to infectious abortion of cattle, and the characteristics of certain species of Mexican cattle ticks with relation to the transmission of tick fever. As for several years past, he has collected statistics on the occurrence and distribution of blackleg in Missouri.

Horticultural work has included some breeding work with peaches to increase hardiness and observations with apple trees as to the

influence of manures on resistance to disease, particularly bitter rot. Spraying demonstrations have been conducted and there have been studies of variation in the growing period of trees from different latitudes, the selection and bud propagation of strawberries, the time of formation of fruit buds, the physical character of the fruit soils of the State, sunscald, and mushroom culture.

The soil survey of the State which the station is making has been completed in three counties and the principal soil types of the entire southern half and northeastern quarter of the State have been outlined and defined. Field tests of systems of cropping and manuring, and in some cases of drainage, have been in progress on sixteen soil types. Some of the results have been very suggestive, indicating that very few soil types in Missouri are in need of potash or lime but that practically all respond readily to applications of phosphoric acid and nitrogen. The station has already, as a result of this work, been able to outline for many sections crop rotations in which the nitrogen and humus could be supplied through the growth of legumes, thereby obviating the necessity of purchasing plant food other than phosphoric acid.

Systematic plats for breeding corn, wheat, oats, cowpeas, clover, etc., in rotations and with grasses and other crops have been laid out on the station farm, but the conditions are not well suited to experimental field work and for this reason the extensive cooperative work, supplementing the soil survey, has been of special importance. Variety tests of corn have been organized largely through the cooperation of the State Corn Growers' Association and have been carried on with 125 farmers representing more than 100 counties. Similar cooperative work has been conducted with alfalfa, cowpeas, wheat and oats, and with grasses to ascertain those best adapted to the Ozark region. A law passed by the last legislature, which provides for the establishment of experimental farms in each county under the joint management of the county courts and the station, is expected to facilitate still further the extension of local experimental work.

The publications of this station received during the past fiscal year included Bulletins 70, Analyses of commercial fertilizers; 71, The fruit-tree leaf-roller; 72, Alfalfa growing in Missouri; 73, Cowpeas; and 74, The winterkilling of peach buds as influenced by previous treatment; and Circular 20, Directions for making Bordeaux powder.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation .....	3,621.04
Fees .....	5,407.10
Farm products.....	7,263.03
Balance from previous year.....	161.48
Total.....	38,452.65

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The Missouri Station is steadily improving its equipment and extending its work in the more scientific lines under the Adams Act and in practical lines by cooperation with farmers and farmers' organizations in different parts of the State.

**Missouri State Fruit Experiment Station, *Mountain Grove.***

PAUL EVANS, *Director.*

The Missouri State Fruit Experiment Station devoted its attention chiefly to the development of fruit growing in the southern part of the State, the lines of work including horticulture, vegetable pathology, entomology, and the inspection of orchards and nurseries. The publications received were Circulars 2, Pruning peach trees, and 3, Pear blight; and the Biennial Report, 1905-6. No Federal funds are expended at this station. Its income for the biennium 1907-8 was \$40,700.

#### MONTANA.

**Montana Agricultural Experiment Station, *Bozeman.***

Department of the Montana College of Agriculture and Mechanic Arts.

F. B. LINFIELD, B. S. A., *Director.*

The Montana Station has received increased appropriations from the State legislature, through which it has been enabled to improve its facilities and extend its work. An agricultural building to cost \$80,000 was authorized for the joint use of the college and station, and a greenhouse has been completed. For farmers' institutes, \$15,000—an increase of \$7,000—was appropriated, and F. S. Cooley, of the Massachusetts Agricultural College was added to the staff for this work. About \$3,000 has been expended for pure-bred stock and \$2,000 additional is available for the purpose. The station received \$15,000 for maintenance and \$6,000 for experiments in dry farming, an increase in each case of 50 per cent.

A permanent dry-farming substation has been established in Fergus County with \$1,000 per year for maintenance, the county contributing the buildings and 160 acres of land. Cooperative work has been arranged for with the Bureau of Plant Industry of this Department and will be continued with the Northern Pacific and Great Northern railways, these corporations contributing from \$4,500 to \$5,500 for the purpose.

The station has the following projects under the Adams fund: Formation of nitrates in irrigated and unirrigated soils; studies of methods of conserving the rainfall in semiarid regions, and its utilization by crops; irrigation investigations, relating especially to seep-

age waters; conditions of the incubation of eggs in arid regions; studies of several diseases of orchard trees; the development of sugar beets for Montana by breeding on the dry bench lands; and life-history studies of a number of sugar-beet insects. Work on most of these projects has been actively carried on the past season. The investigations were carefully planned and several of them involve original and important features applied to the arid regions.

In response to a demand for fruit investigations, a horticultural substation has been established in the Bitter Root Valley, where 20 acres of land given by the local community is devoted to a study of cultural methods of orchard fruits and the effect of irrigation on the growth of fruit, together with variety testing of apples, pears, cherries, plums, small fruits, and a few vegetables. A special study is being made of the cause of failure to set fruit, which is a serious difficulty in the State. A fruit survey of the valley has been made as a basis of fruit work, and similar surveys of two other regions are contemplated. Cooperative experiments in thinning fruit have been made in several orchards of the region.

The work at Bozeman has remained much as in previous years. In agronomy and horticulture there have been variety testing and irrigation and cultural experiments with a number of crops. The dairyman has studied the effect of feeding milk treated with formalin, and has cooperated with the animal husbandman in other feeding experiments with the dairy herd. In connection with studies of the difference in the melting point of butter from cream kept different lengths of time, a chemical study is planned of the effect on the butyric. The chemist was succeeded during the year by Edmund Burke, who is expected to devote himself exclusively to station work.

In animal husbandry, feeding work with carload lots of cattle and sheep indicated that the grain ration may be reduced one-half, and for pigs tankage and sugar beets have given good results as supplements to grain. There has also been some feeding work with poultry and a study of incubator problems.

The only publications received from this station during the fiscal year were Bulletins 61, Food adulteration, and 62, Third annual report of the State entomologist; and the Annual Report for 1905. A number of other publications have since been received.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	15,000.00
United States appropriation, Adams Act.....	4,417.13
Balance from previous year, Adams Act.....	2,582.87
State appropriation.....	9,790.14
Farm products.....	5,982.68
Individuals.....	2,401.82
Total .....	40,174.64

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The Montana Station is in a prosperous condition and its work is being energetically prosecuted. The people of this great State are evidently becoming more alive to its agricultural possibilities, and are more strongly supporting the station in its efforts to extend and strengthen its work.

### NEBRASKA.

#### *Agricultural Experiment Station of Nebraska, Lincoln.*

Department of the University of Nebraska.

E. A. BURNETT, B. S., *Director.*

The Nebraska Station had under way during the year eight projects under the Adams fund. These related to studies of the nature and composition of humus, effect of soil moisture on winter injury of fruit trees, studies of heredity in certain horticultural crops, the bleaching of wheat flour, study of several new and little known plant diseases, the poisonous principle in cornstalk disease, loco poisoning of horses, and the effect of different methods of feeding on the bones of growing pigs. The work on the bleaching of wheat flour was completed and has been reported upon. That on the loco poisoning of horses was also closed at the end of the year.

In addition to this work, the agronomist has about 80 acres in plats, 30 acres of which are in corn. A breeding experiment for yield is in progress, 200 ears being used in each series. A correlation has been found between germination and yield, but the highest germination does not seem to be necessarily desirable. The size of ear as related to the leaf area and other correlations are being determined, and experiments on the rate of planting as related to differences in varieties are being carried on with five sorts. Cooperative experiments have been made with 100 farmers, each growing 10 varieties, and in the western part of the State there is a cooperative experiment with 45 farmers to test the relative value of varieties which have been grown for some time in particular regions. Besides the work with corn there are systematic tests and breeding experiments with barley, wheat, alfalfa, etc., partly in cooperation with the Bureau of Plant Industry of this Department.

Horticultural work has followed the general lines of former years. Among other lines there is a somewhat extensive study of potatoes, including experiments in plowing, methods of planting, size of seeds, varieties, and similar details. Orchard demonstrations of the effect of spraying are being carried on in two orchards outside the sta-

tion, and there are also experiments in orchard tillage and peach breeding.

In botany there have been special studies of seeds, particularly of grasses and legumes, investigations of barley smut, including spraying experiments, studies of weeds injurious to alfalfa, and a plant survey in cooperation with the Bureau of Plant Industry. In addition to other funds, a State appropriation of \$1,000 is available for studies of fungus diseases.

Animal husbandry continues to receive much attention, especially the feeding trials with beef cattle. Alfalfa, oil meal, cotton-seed meal, and bran were compared as supplements to corn for fattening, with 60 two-year-old Aberdeen Angus steers. The gains at least cost were in the order named, thereby indicating that protein may be grown in the form of alfalfa at a price much below its cost in concentrates. In another experiment five-month gains with a heavy corn ration in addition to alfalfa and corn stover were no greater than six-month gains on a similar ration with one-half the amount of corn. The feeding trials thus far conducted have been restricted to results from pens of animals, but it is planned to secure also records of individual animals in the future.

In the work of animal pathology several treatments for hog cholera have been tested, together with studies of the causes of weak backs in hogs, the effectiveness of the tuberculin test, and the detection of tuberculosis in hogs by other means. A State appropriation of \$1,000 is available for the tuberculosis work, in which the Bureau of Animal Industry and several packing houses are cooperating.

An increase from about \$6,000 to \$10,000 for farmers' institutes was granted by the last legislature, besides \$100,000 for new buildings to the university, including \$30,000 for a stock and grain judging pavilion and \$15,000 for a steer-feeding plant, tool barn, and similar purposes.

For the substation at North Platte \$25,000 is available for the current biennium, of which \$10,000 is to be used for permanent improvements. The plant at the substation now consists of a large farm, partly on first bench land about 30 feet above the water table and partly on upland. On the bench land there are field experiments covering about 100 acres devoted to alfalfa, wheat, corn, and barley, and to a comparison of different methods of tillage. Similar experiments are under way on about 100 acres of the upland and also with grasses, much of the work being in cooperation with the Bureau of Plant Industry of this Department. An orchard has been planted and a forest plantation is being begun in cooperation with the Forest Service. The substation also has about 1,500 acres in pasture for feeding a considerable number of cattle to study the

problem of how best to combine range feeding with the winter feeding of cultivated crops, and is conducting feeding trials with hogs. The buildings include a residence and office for the superintendent, a large barn, cottages for workmen, etc., and a soils laboratory is being erected.

During the fiscal year seven bulletins and two annual reports were received from this station, as follows: Bulletins 92, Cover crops for young orchards; 93, Cattle-feeding experiments; 94, Fattening pigs on corn and tankage; 95, Crop production in western Nebraska; 96, Some insects injurious to wheat during 1905-6; 97, Potato experiments; and 98, Spraying demonstrations in Nebraska apple orchards; and the Annual Reports for 1905 and 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation, including substation.....	10,175.00
Farm products.....	17,905.47
Balance from previous year.....	6,749.64
Total .....	56,830.11

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the Nebraska Station as a whole is being carried on energetically and systematically. The station has been greatly strengthened in recent years, and is evidently receiving the support of its local constituency in larger measure than ever before.

#### NEVADA.

##### Nevada Agricultural Experiment Station, *Reno*.

Department of Nevada State University.

J. E. STUBBS, D. D., LL. D., *Director*.

At the Nevada Station several new lines of work have been inaugurated and others have been much extended in scope. A department of bacteriology and veterinary science has been equipped, and, in cooperation with the botanist, some studies have been made of fire blight, the results of which are awaiting publication. Through a rearrangement of duties the entire time of an entomologist is now available for station work, the principal studies of the year being of elm scale, wingless grasshoppers, and egg parasites of different insects.

The station undertook work under the Adams fund on the following five projects: Breeding alfalfa for frost, drought, and insect re-

sistance; investigation of the active principles in poisonous plants; nutritive value of native forage grasses and plants; feeding value of alfalfa; and meteorological and climatological studies on Mount Rose (10,800 feet altitude) in relation to the valley below.

In agriculture and animal husbandry, feeding trials were continued with Tamworths and Berkshires for bacon production and with grade Holsteins, using alfalfa, alfalfa meal, and other feeds, and an experiment was made with Dorset sheep to determine the profits in raising early lambs for the San Francisco market. The State fair grounds at Reno have been leased for the production of forage and for the housing of the stock. Different varieties of wheat, barley, oats, and alfalfa are being grown, and a State appropriation is available for irrigation investigations in cooperation with this Office. These have taken the form of studies of the water requirements of wheat, barley, and oats, both at Reno and other points, to determine the value of different methods of winter irrigation.

The botanist has begun a somewhat comprehensive study of clovers, especially with reference to the economic value of the native species. A study of leguminous cover crops for orchards is awaiting publication. The relation of timber to the melting of snow and to the water supply has been taken up in cooperation with the meteorologist, and data are being collected as to the second growth of timber on the eastern Sierra Mountains.

A State appropriation of \$5,000 per annum has been made to the board of regents for a substation in Lincoln County, but not as a part of the station fund. A tract of land has been secured and is being put into shape for experimental work. A limited amount of the appropriation is to be used for buildings and equipment.

The university has received from Clarence H. Mackay a gift of a new mining building, an administration building, and funds for the laying out of the grounds and the endowment of a mining course. An agricultural high school in connection with the university has been organized and will open for instruction September 4, 1908.

During the year three bulletins, namely, Bulletins 60, The weather of 1905; 61, Ornamental and shade trees, and 62, Native forage plants and their chemical composition; and the Annual Report for 1905, were received from this station.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	6,772.94
Balance from previous year, Adams Act.....	227.06
Farm products.....	2,569.19
Miscellaneous, including balance from previous year...	982.42
<b>Total</b> .....	<b>25,551.61</b>



A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The Nevada Station is expanding its activities and its outlook for the future is more promising. With the increase in its income this station now has an opportunity for the thorough study of problems of great importance to the arid region.

#### NEW HAMPSHIRE.

*New Hampshire College Agricultural Experiment Station, Durham.*

Department of New Hampshire College of Agriculture and Mechanic Arts.

E. D. SANDERSON, B. S. A., *Director.*

At the close of the fiscal year the directorship of the New Hampshire Station was separated from the presidency of the college, and the entomologist was appointed director. There were also a number of other changes in personnel including the dairyman, horticulturist, and the assistants in horticulture and animal husbandry, and an assistant agriculturist was added to the staff. The equipment of the station was increased by the erection of a sheep barn.

The work of the station under the Adams Act embraced the following projects: Causes and means of control of fruit-bud formation on the apple; investigations on several apple diseases; availability of the potash in strong clay soils and conditions affecting it; life history studies on the codling moth in relation to remedial measures; relation of temperature to the transformations and mortality of insects; factors influencing the production of early spring lambs; and corn breeding with dent varieties. At the close of the first year's work it was deemed best to transfer the last two projects to other funds as being more appropriately assigned there in their present stages. Good progress was made in the other lines of work. A number of important points in relation to the life history of the codling moth were cleared up, and the investigations in that line were nearly completed.

In a study of fruit spot the botanist has shown that this trouble is caused by a fungus disease which he has isolated and that it can be controlled by spraying at the proper season. The spot is very common in Baldwins and other varieties of apples in the region and is one of the worst handicaps to apple growing as the black spots cut down the market price considerably. In connection with these studies an orchard of about 300 trees and located about 3 miles from the station has been leased for a term of years.

The chemists have shown from their studies of soil acidity that practically none of the soils in the region which give an acid reaction to litmus paper yield a solution which is acid. It is believed that

such so-called acid soils are not acid and that the beneficial action of lime on these soils is due not to its neutralization of their acidity but to other causes, partly physical and partly as yet unknown.

Other work of the station has included a study of the life history and methods of control of the striped cucumber beetle by the entomologist. The horticulturist is making an orchard survey of southern New Hampshire and is continuing on an extensive scale his breeding and crossing work with peppers, cucumbers, potatoes, violets, squashes, sweet corn, and in the greenhouse, quite largely with carnations, in an attempt to discover the law of color. The agriculturist has breeding work under way with dent and flint corn to obtain a strain suitable for northern New Hampshire, and is comparing methods for securing a good stand of alfalfa. His results indicate that alfalfa can be grown in New Hampshire and that the best methods are similar to those found successful in other States.

In cooperation with farmers, some spraying of apples and potatoes was carried on. It is the expectation to continue this work and to add demonstrations in potato growing and herd testing and to hold a butter-scoring contest. A need is expressed at this institution for more extension work of this sort for the purpose of bringing improved methods more immediately before the farmers of the State and an effort is to be made to secure a State appropriation for this purpose. Members of the station staff assisted in many of the farmers' institutes and also addressed teachers' institutes on the study of agriculture in the public schools.

The publications received from this station during the year were as follows: Bulletins 127, The feeding of farm stock; 128, The brown-tail moth and the gipsy moth in New Hampshire in 1906; 130, Inspection of fertilizers in 1906; and 131, Spraying the apple orchard.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
Fees .....	2,012.42
Total.....	24,012.42

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the New Hampshire Station has been materially strengthened in a number of directions and with a special administrative officer to direct its efforts it seems in a position to be an important force for the improvement and advancement of agriculture in the State.

## NEW JERSEY.

New Jersey State Agricultural Experiment Station, *New Brunswick.*

At Rutgers College.

E. B. VOORHEES, D. Sc., *Director.*

New Jersey Agricultural College Experiment Station, *New Brunswick.*

Department of Rutgers College.

E. B. VOORHEES, D. Sc., *Director.*

The investigations of the New Jersey stations under the Adams Act have been restricted to two general lines of investigation, namely: Plant-breeding investigations and bacteriological soil investigations with studies of the relation of microscopic life to the development of available plant food in the soil and to soil fertility in general. The character of the plant-breeding investigations is well described in a recent publication of the station in which it is explained that—

instead of making the production of new and improved kinds of vegetable fruits an end, such sorts become a by-product (of no small account, however) in searching for the rules that underlie the amelioration of plants. \* \* \* In other words, the department addresses itself to problems, the solution of which is expected to aid the future crop growers to a position where they or their posterity may become breeders, etc.; in short, its province is primarily to determine facts and establish principles, and secondarily, to provide improved sorts of seeds and plants.

In both lines of work extensive investigations are in hand which are prosecuted both in the field and in the laboratory. The bacteriological soil investigations are the most extensive and thorough to be found anywhere in this country.

Aside from the Adams Act projects, the work of the stations has been largely in the development and broadening of lines already established and in the inauguration of experiments in forestry. A tract of about 20 acres has been acquired for forestry work and about 25,000 trees and seedlings have been planted, including seven varieties of hardwoods and four of conifers. Further plantings will be made from time to time and a comparison of different dates of planting and other questions will be taken up.

An orchard of dwarf apples has been set out for the purpose of securing more immediate results in fertilizer trials. The plant-breeding work has been continued, and is yielding results of both scientific and practical interest (figs. 6 and 7). As new lines of work, variety and fertilizer testing of strawberries, and studies of the value of the sand cherry as a peach stock, and of the control of mushroom maggots have been begun. In the extensive inquiry as to peach growing in the State, the experimental orchard in Hunterdon County was

maintained and a new orchard was established in the second peach-growing section of the State at Vineland.



FIG. 6.—New type of tomato with few seeds, New Jersey stations.

Some tests of insecticides, particularly as to their absorption by trees as a possible effect of application, while not regarded as con-

clusive suggest that the trees may absorb into the sap sufficient insecticide to injure insects, especially San José scale. Studies of the cabbage and other root maggots are in progress, and the entomologist is vigorously prosecuting with State funds the campaign for the eradication of mosquitoes. A State appropriation of \$3,000 is also available for nursery inspection. The annual appropriation of \$200 for the investigation by the biologist of oyster propagation has been increased to \$1,200, making possible the provision of considerable additional equipment.

Owing to the resignation of the chief chemist to accept a similar position at the Connecticut State Station, the study of the carbohydrate group of nutrients in feeds has been temporarily suspended.



FIG. 7.—Hybrid eggplants, American-Chinese cross to improve keeping quality, New Jersey stations.

The position has been filled by the appointment of C. S. Cathcart, at one time an assistant at the station, but subsequently engaged in commercial work.

In dairying the scope of the experimental work was enlarged, the chief lines including the growing of soiling and cover crops, feeding trials with a variety of soiling crops and with corn distillers' grains, and the keeping of records as to the cost of production of sanitary milk. An animal husbandman was added to the staff, and a special study was made of the live-stock interests of the State in connection with the work of a commission appointed to inquire into conditions and recommend methods of improvement.



Through a gift of an alumnus the college has acquired about 40 acres of additional land for the farm and \$1,000 has been provided for buildings. A new barn and stock judging pavilion are being constructed exclusively for the short-course work. A State appropriation of \$25,000 is also available for the maintenance of the short courses, which are proving very successful.

During the year eight bulletins were received from the stations as follows: Bulletins 195, Analyses of Paris green; 196, Analyses and valuation of commercial fertilizers; 197, Suggestions on the renewal of the peach industry in New Jersey; 198, Analyses and valuations of commercial fertilizers and ground bone; 199, Station novelties in truck crops; 200, The cabbage and onion maggots; 201, Concentrated feeding stuffs; and 202, Forest trees of New Jersey.

The income of the stations during the past fiscal year was as follows:

State Station: State appropriation (fiscal year ended October 31, 1907)-----	\$48,500.00
College Station:	
United States appropriation, Hatch Act-----	15,000.00
United States appropriation, Adams Act-----	7,000.00
Total-----	70,500.00

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The New Jersey stations continue to conduct a large amount of important investigation which is of fundamental importance. Their more practical studies have been of great value to the farmers of the State, with whom they are in close contact and sympathy.

#### NEW MEXICO.

*Agricultural Experiment Station of New Mexico, Agricultural College.*

Department of New Mexico College of Agriculture and Mechanic Arts.

LUTHER FOSTER, M. S. A., *Director.*

The status of the New Mexico Station as regards its general organization and work remains much the same as in previous years, except for the appointment of an irrigation engineer and several new assistants, and the undertaking by the vice-director of a more thorough survey of the agricultural conditions and possibilities of the Territory. The specific aim in the latter work is the organization of local agricultural societies or institutes with a view to their cooperation with the station in demonstration experiments and similar enterprises. Farmers' institutes have been held in practically all the agricultural districts of the Territory and farmers' societies have been organized in most of the localities.

The station has conducted investigations upon the following projects under the Adams fund: Coloring matters of cacti; studies of cacti in relation to food value; sugars in cactus fruits; crown-gall investigations; possibilities of guayule as a rubber-producing plant; improvement of Mexican chili by breeding and selection; investigations upon the life history of the codling moth; nutritive effect of certain feeds in the production of beef from range steers; and a comprehensive study of the relations of the soil, the water, and the crop in respect to irrigation and to dry farming supplemented by irrigation. The above is a relatively large number of projects considering the resources of the station. The last project is recognized as of great importance and is planned to be carried out in a thorough and systematic manner. In this respect it is the most thorough investigation of its kind which has been undertaken, involving a good deal of laboratory work. It is planned in future to use a quite large proportion of the Adams fund in connection with it.

The station has in progress a novel attempt to combat the codling moth in Dona Ana County by eliminating its food supply. The weather conditions of the season were unusually favorable for the experiment, as a severe freeze in April killed practically all of the fruit in the county. All the orchards were then given a thorough inspection and any fruit found on the trees was destroyed, thereby effecting, it is hoped, the starvation of the entire second brood. To prevent the reintroduction of the pest, all fruit shipped into the county from other sections was inspected and destroyed if found wormy.

Variety testing of wheat has continued and seed of improved sorts is now available for distribution to farmers of the Territory. A comparison of old land and alfalfa sod for onions indicated that the use of new sod is not advisable, as the alfalfa continues to grow and interferes with the proper cultivation of the crop. A bulletin has been issued on conditions and methods of dry farming, and extensive co-operative experiments with farmers are planned to demonstrate crops best suited to these and other prevailing conditions. Seeds of crops grown in different parts of the Territory by dry-farming methods are to be secured and planted on the dry mesa land at the station.

Poultry experiments have been begun during the year and observations on pastures for sheep and on soiling are being made. Through an arrangement with a local horse-breeding society, a French coach stallion has been procured and it is hoped to take up systematic experiments in the breeding of saddle horses under range conditions.

The improvement of ranges is a matter of paramount importance in the Territory and the botanist is giving much attention to the study of range conditions, the grasses and forage plants best suited to these

conditions, and the best methods of propagation. Special attention is given at present to the propagation of native species of cacti by seeds and by cuttings, and it is hoped to extend the work to the breeding of range plants. There is also a study of the topographical distribution of grasses.

Chemical work has dealt largely with the utilization of cacti, with some studies of the distribution of bat guano in the Territory. Analyses have also been made of several vegetables and fruits to determine their nutritive value as compared with those grown in the East.

Irrigation investigations have been extended by the addition to the staff of B. P. Fleming of the irrigation investigations of this Office as irrigation engineer. A pumping plant is being installed preliminary to a comprehensive study of the water requirements of soils and crops. The work is already attracting much attention in the Territory as showing the best means of utilizing small amounts of water under the prevailing conditions of water shortage.

Publications were received from this station during the year as follows: Bulletins 56, The duty of well water and the cost and profit on irrigated crops in the Rio Grande Valley; 57, Steer feeding; 58, European grapes; 59, Forty years of southern New Mexico climate; 60, Prickly pear and other cacti as food for stock; and 61, Dry farming in New Mexico; and the Annual Report for 1905.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000. 00
United States appropriation, Adams Act.....	7,000. 00
Farm products.....	2,170. 93
Miscellaneous.....	1,190. 79
Total.....	25,361. 72

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The New Mexico Station has extended its activities in a number of important scientific and practical lines during the year. The demands upon the station for practical assistance, particularly from new settlers, have become so great that it seems incumbent upon the Territory to extend more liberal financial support to the station, thus making it less difficult for the station to maintain a high order of scientific investigation in agriculture and at the same time meet the practical and popular needs of the farmers of the Territory.



## NEW YORK.

New York Agricultural Experiment Station, Geneva.

W. H. JORDAN, D. Sc., *Director*.

The work of the New York Station was mainly a continuation and development of the lines already under way, with attention both to research and practical demonstrations. In bacteriology there have been studies of the bacterial diseases of cabbage, the flora of cheese, the problems arising in the canning of vegetables, and the natural distribution of alfalfa bacteria in the soil. Large numbers of samples of inoculated soil from the station farm have been distributed among farmers. In cooperation with the dairy department a milking machine has been tested, attention being given to its economy as compared with hand milking and its effect on milk production and the bacterial content of the milk.

The principal investigations in animal industry have been a continuation of the studies of metabolism in milch cows and in the use of concentrated by-products in feeding poultry. Breeding experiments with poultry are also in progress to ascertain the effect of line breeding and inbreeding upon vitality, egg production, fixity of type, and similar points.

In botany studies in plant nutrition have been continued together with investigations of dodder and other alfalfa pests, currant cane blight, a new muskmelon disease, and the bud rot of carnations. Potato-spraying experiments have been conducted as in previous years at the station, on Long Island, and in cooperation with many farmers throughout the State, and have led to the more extended adoption of the practice.

In chemistry the problems have included cheese ripening, the action of acids upon casein, the preparation and use of koumiss, changes in the souring of milk, the relation of the inorganic constituents in milk to the casein, and the development of methods of estimating lactic acid and lactates. A series of experiments in the carbonation of milk by charging with carbon-dioxid gas at pressures of from 70 to 175 pounds per square inch indicated that the bottled milk, either when pasteurized or unpasteurized prior to carbonation, could be kept for several months at temperatures ranging from 35° to 70° F. with little increase in acidity. The carbonated milk was found to be a palatable beverage, and it is believed that its use may be often found advantageous, as for invalids and children and on shipboard.

Entomological studies have included the means of combating flea beetle and cabbage maggot on cabbage seed-beds, the life histories of apple, pear, and maple mites, and the winter spraying of nursery stock to destroy aphid eggs. Some commercial experiments in controlling scale in old apple orchards indicated that comparative free-

dom from scale may be obtained at a cost of about 40 cents per tree per year. The dipping of the roots of nursery stock in any of the ordinary insecticides was investigated and shown to be a dangerous practice.

A monograph on the grapes of New York is being prepared by the horticultural department and other fruits are to be taken up later. Other work in progress includes fertilizer experiments with apples, the comparison of tillage and sod mulch in orchard management, a study of the growth and behavior of dwarf apples and of grapes on resistant stocks, the development of a fungicide that will not injure fruit, observations on hardiness in peach trees, studies in plant breeding and miscellaneous greenhouse work with tomatoes, lettuce, cucumbers, and muskmelons.

The station outlined two projects which it is conducting in part with its share of the Adams fund, viz, a further study of the compounds in cheese and their changes under the influence of certain classes of bacteria, and studies of the metabolism and physiological effect of certain compounds fed to animals. In both lines the investigations are in continuation of studies which have been going on for a number of years.

The twenty-fifth anniversary of the establishment of the station was observed by appropriate field day exercises August 29, 1907. The attendance numbered over three thousand, and the list of speakers included the governor of the State, members of Congress and the State legislature, representatives of the State department of agriculture and the State grange, President W. O. Thompson, of Ohio State University, Dean L. H. Bailey, of Cornell University, the director of the station, and the surviving member of the first board of control. The substantial nature of agricultural progress during the last generation and the influence of agricultural research in this development formed the central theme for many of the speakers, and the exercises were of much significance as a recognition of the value of the experiment stations to the public.

The station has begun the publication of a series of technical bulletins for restricted distribution, those issued during the year including Technical Bulletins 1, A study of the metabolism and physiological effects of certain phosphorus compounds with milch cows; 2, An outbreak of the European currant rust; 3, The action of dilute acids upon casein when no soluble compounds are formed, The hydrolysis of the sodium of casein; 4, Some of the first chemical changes in Cheddar cheese, and the acidity of the water extract of Cheddar cheese. Other publications of the station received during the year were as follows: Bulletins 280, Inspection of feeding stuffs; 281, Commercial miscible oils for treatment of the San José scale (with popular edition); 282, Quality of commercial cultures for

legumes in 1906; 283, The apple and pear mites (with popular edition); 284, Director's report for 1906; 285, Report of analyses of samples of fertilizers collected by the commissioner of agriculture during 1906; 286, An enemy of poplars and willows (with popular edition); 287, Bordeaux injury (with popular edition); 288, Ringing herbaceous plants (with popular edition); and the Annual Report for 1905.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$1,415.27
Balance from previous year, Hatch Act.....	84.73
United States appropriation, Adams Act.....	700.00
State appropriation, including balance from previous year .....	92,991.63
Total.....	95,191.63

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

Through the liberal support accorded it by the State, the New York State Station has at its disposal a large fund for its work. It has combined in a happy manner substantial research work with more practical experiments and demonstrations in different localities of the State.

**Cornell University Agricultural Experiment Station, Ithaca.**

Department of New York State College of Agriculture at Cornell University.

L. H. BAILEY, M. S., *Director*.

The year at the Cornell Station has been a period of reorganization and readjustment to a new environment. The elaborate series of buildings described on page 266 was occupied during the year, but the prosecution of many investigations was considerably handicapped by delays in the completion and installation of equipment. There were several additions to the staff during the year and plans were formulated for further differentiation of the instruction, extension, and experimental work in agriculture of the university. With the opening of the State fiscal year, October 1, 1907, it is planned to concentrate the station activities for the present mainly upon the departments of soils, plant biology, and entomology, and to restrict the grade of the work more closely to research.

During the year the station confined its work under the Adams Act to three main lines, i. e., principles of plant breeding and heredity; soil studies, especially as related to methods for the determination of fertilizer requirements, conditions affecting the soil solution, and certain conditions detrimental to crop production, and entomological investigations. The latter were confined during the past year to certain insects infesting timothy grass. These investigations have been

planned in a thorough and careful manner, and promise important contributions to our knowledge. The resources of the station will be to a very large extent placed at their disposal. In connection with the soil studies, a system of concrete tanks for soil cultures is to be installed, and a greenhouse is being built for use in these studies and in plant breeding.

The work on the improvement of timothy inaugurated last year has been continued on an extensive scale, the plats covering about 15 acres and including 20,000 individual plants. Other lines to receive attention were the following: Monographic studies of peonies and garden beans, various experiments with root crops, the effect of weeds on corn, factors influencing the growth of clover, the etherization of plants, the effect of the acetylene light on plants, bean anthracnose, black rot of grapes, the Septoria of tomatoes, ginseng diseases, life history of rhododendron lace-bug, a leaf miner of *Arbor vitæ*, an apple-seed insect, oyster-shell scale, rose chafer and insects attacking violets, miscible oils for sprays, studies of the milk supply of Ithaca as a preliminary to a general investigation of market milk production, the control of moisture in butter, early lamb raising, beef production in New York, the use of skim milk in pork production, factors affecting the fertility of eggs, and various feeding and housing problems with poultry. Cooperative work with this Department has been conducted in studies of peach diseases and breeding experiments with cereals.

Extension work with farmers has embraced a large number of cooperative experiments and demonstrations, chiefly through the agency of the State Agricultural Experimenters' League. A variety of work has been taken up, including agricultural and horticultural surveys for some of the counties, a plant disease survey of the State, a reconnaissance soil survey, spraying trials for grape rot in vineyards, farm drainage experiments, studies of alfalfa and clover production, and the inspection of creameries and butter factories. There has also been a continuation of nature study work, reading courses for farmers and farmers' wives, and the winter course instruction.

The publications of the station received during the fiscal year were as follows: Bulletins 240, The influence of mushrooms on the growth of some plants; 241, Second report on the influence of fertilizers on the yield of timothy; 242, Cabbages for stock feeding and list of cooperative tests for 1907; 243, Root crops for stock feeding; 244, Culture and varieties of roots for stock feeding; and 245, Spray calendar.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$13,500.00
United States appropriation, Adams Act.....	6,182.85
Balance from previous year, Adams Act.....	117.15
<b>Total .....</b>	<b>19,800.00</b>

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The teaching, extension, and experimental staff of the college of agriculture now numbers about 80 persons. The State appropriation for the current year aggregates \$225,000, of which \$150,000 is for maintenance, \$50,000 for equipment, and \$25,000 for new barns.

#### NORTH CAROLINA.

**North Carolina Agricultural Experiment Station, West Raleigh.**

Department of North Carolina College of Agriculture and Mechanic Arts.

C. B. WILLIAMS, M. S., *Director*.

At the close of the year the management of North Carolina Station, together with that of the college, was taken from the control of the State board of agriculture by act of the legislature and vested in an entirely distinct governing board. The work conducted under Federal funds was thereby separated from that of the State department of agriculture, with the result that two separate stations were formed, one connected with the college and the other under the control of the State board of agriculture. The latter was organized as the Agricultural Experiment Station of the North Carolina Department of Agriculture, and the former director of the combined station was placed in charge of it.

The veterinarian, horticulturist, and entomologist also accepted corresponding positions in the latter station, the complete organization of which is given beyond (page 148). C. B. Williams, the former agronomist of the combined station, was elected director of the College Station, and R. I. Smith, State entomologist of Georgia, was placed at the head of the entomological department, while the horticultural and veterinary work was temporarily suspended. These changes have resulted in a reorganization of experimental work in North Carolina, which can but work to its temporary disadvantage. The former relations with the State department of agriculture had proved very helpful and had enabled an exceptionally strong and efficient station to be developed. The two stations plan to cooperate in their work in various ways, and this will be desirable from the standpoint of both.

The following investigations were outlined to be conducted under the Adams fund: Relation of geology and chemistry of typical soils to productivity and fertilizer requirements; studies of nitrification, including the nitrifying power of different soils; and investigation of certain apple and lettuce diseases. Several other projects were suggested which were not undertaken on account of the interruption caused by the reorganization of the station.

The general work of the station proceeded along the lines hitherto undertaken. Considerable attention was given to plant diseases and also to studies of tobacco, sweet potato and watermelon wilt, and a disease of cultivated chrysanthemums. Breeding for wilt resistance yielded good results, and the possibility of combating the Granville tobacco wilt by this means seems assured, as at least 90 per cent of resistance was obtained on some varieties. The work with watermelon wilt was in cooperation with the Bureau of Plant Industry of this Department.

Trials with field crops, vegetables, and fruits were extensively conducted, the work being in part on the station farm but largely on the four State farms controlled by the State board of agriculture. A bulletin, No. 194, on muskmelons was issued and was the only publication to be received from the station during the year.

Miscellaneous work included a cooperative study by the agronomist and dairyman as to the utilization of available home-grown foods for dairy cattle, some observations on the effect of terracing as a means of conserving soil fertility and moisture aside from the prevention of erosion, and studies of cabbage insects. Trials of arsenate of lead for the control of flea beetles on tobacco indicate that it is a very efficient means of control, especially in the seed bed. The veterinarian, in cooperation with the Bureau of Animal Industry of this Department, found that in the eradication of cattle ticks five sprayings with an emulsion of crude oil at intervals of three weeks were sufficient. The poultryman studied pedigree breeding with ten breeds for egg production, the value of green food for chickens, and the comparative keeping qualities of fertile and infertile eggs. There were also studies of the plant-food requirements of a number of the common crops, especially cotton and corn, on different types of soil.

The correspondence of the station was very heavy and required much attention. There was also a limited amount of participation in farmers' institutes. An agronomist was added to the staff and additional assistance provided in plant pathology and bacteriology.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation.....	17,000.00
Farm products.....	696.78
Miscellaneous.....	173.86
Total.....	39,870.64

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

For the ensuing year no State appropriation will be available for this station, which will mean a diminution in its income equivalent to about \$17,000. In view of the restrictions governing the use of Federal funds, this reduction of income may be severely felt.

**Agricultural Experiment Station of the North Carolina State Department of Agriculture, Raleigh.**

B. W. KILGORE, M. S., *Director.*

The North Carolina State Station was established July 1, 1907, as a department of the State department of agriculture, as outlined above. The organization and lines of work to be undertaken at present are as follows: B. W. Kilgore, director, farm crops; Tait Butler, veterinarian, animal husbandry; W. N. Hutt, horticulturist; Franklin Sherman, jr., entomologist; T. B. Parker, cooperative experiments; W. M. Allen, chemist, foods; C. D. Harris, assistant chemist and microscopist, stock feeds; Miss H. M. Card, assistant chemist, foods; J. M. Pickel, W. G. Haywood, L. L. Brinkley, and S. O. Perkins, assistant chemists; G. M. MacNider, soils; L. M. Smith, assistant entomologist, and R. W. Scott, F. T. Meacham, J. H. Jeffries, and R. W. Collett, superintendents of the substations at Edgecombe, Iredell, Pender, and Transylvania, respectively.

The station offices are located at Raleigh, and the four State farms or substations are located in typical regions of soil or culture for the study of special problems. The annual income of the North Carolina department of agriculture is estimated at about \$80,000, much of which is expected to be at the disposal of the station.

**NORTH DAKOTA.**

**North Dakota Agricultural Experiment Station, Agricultural College.**

Department of North Dakota Agricultural College.

J. H. WORST, LL. D., *Director.*

Liberal appropriations to the North Dakota Station by the State legislature have enabled it to improve its facilities and greatly increase the scope of its undertakings. For the current year over \$100,000 is available for new buildings for the college and station, the items including \$65,000 for an engineering building, \$6,000 for an experimental milling plant with \$500 annually for maintenance, \$6,000 for horticultural greenhouses, and \$10,000 for a seed barn and root cellar. There are also appropriations of \$10,000 for the enforcement of the State pure-food laws, \$7,500 for the establishment of demonstration farms, and over \$30,000 for the equipment and maintenance of substations.

Of the twelve demonstration farms provided for, six are already organized on a cooperative basis under the supervision of the agricul-

turist. A 5-year rotation is to be continued on 4-acre plats, with some variety testing. Most of the farms are located in the arid section of the State, and moisture determinations and rainfall records will be kept in most cases.

Work at the substations at Dickinson and Edgley has been continued, the chief line being the variety testing of fruits. Provision has been made for an additional substation at Williston for the study of irrigation and dry-farming methods.

The station's projects under the Adams fund relate to the nutrition of the wheat plant and its relation to soil conditions; the effect of bacteria and fungi of the soil upon its physical, mechanical, and chemical



FIG. 8.—Experimental milling plant, North Dakota Station.

conditions; studies of the milling qualities of wheat as affected by varieties, strains, soil, and other factors; relation of bacteria and fungi of soil to cropping methods; study of the principles underlying the development of disease resistance or immunity in farm crops; and tree physiology and medication.

Some difficulty has been experienced by the station in securing assistants for work on the various projects under the Adams Act, but there has been progress in a number of investigations. In connection with this work a large and well-equipped flour-milling plant has been installed, consisting of four research laboratories and a flour-testing room and a flour mill with three sets of double rollers and other appliances. (Fig. 8.)



Through funds furnished by the Paint Grinders' Association, a series of investigations have been undertaken by the chemist on the various pigments and their combinations. Several tons of paint were manufactured from various formulas and tested experimentally on fences and buildings in the vicinity. The various inspection duties, now covering foods and drugs, formaldehyde, Paris green, paints, fertilizers, and feeding stuffs, have largely increased, but additional assistants have been provided and the work has been differentiated to a considerable extent.

A new fruit plantation has been laid out which contains 26 varieties of plums, 18 of apples, 20 of crab apples, bush fruits, etc. Much breeding work is in progress, and that with strawberries has proved so successful on a small scale that a commercial acre is to be grown, and 10,000 plants have been distributed to school children. Celery and cabbages are being grown with special reference to cultural methods to produce disease resistance, sweet corn and tomatoes to obtain earliness, and with flax and wheat for resistance to wilt and rust.

In cooperation with the Forest Service of this Department, a tract of 8 acres has been planted, under a variety of conditions, to 26 species of forest trees, and it is planned to extend the area to 24 acres. A red cedar, from the western part of the State, is believed to be of special economic promise.

The bacteriological laboratory of the division of biology has been largely rearranged and more thoroughly equipped for the study of the indefinite flora of the soil, and T. D. Beckwith, of the Soil Bacteriology and Water Purification Investigations of this Department, has been added to the staff for soil investigations. The plant house of the botanical division has been fitted up with a complete temperature regulation system by which the temperature of any room may be maintained quite constant. The botanist is keeping in touch with farmers of the State by means of press bulletins giving recommendations arising from the work of the station as it progresses.

Experiments in the eradication of weeds in grain fields have been undertaken on a plan more extensive than heretofore. At six different points in the State field demonstrations have been conducted on fields of from 50 to 100 acres each, special attention being given to a study of the machinery most suitable for applying solutions. Several new chemicals have been tested, but so far as iron sulphate and copper sulphate are concerned, no material deviation has been observed from the principles enunciated from the original investigations of the station.

Agricultural work has had special reference to the most profitable utilization of corn and clover, which are now largely grown in the State, the work taking the form, chiefly, of feeding trials with steers

and pigs, and pasture tests with pigs on various combinations of peas, clover, barley, and grass. Poultry work has been considerably developed, and includes studies of inbreeding versus outbreeding, the most economical way of building up scrub stock, the influence of warm and cold houses, incubator work, and similar lines.

A remarkable development has also characterized the work of the college in late years, and over 900 students are now in attendance. The increased funds under the Nelson Act are to be utilized in part for teaching agriculture in the pedagogical course, which is to be lengthened to three years and rearranged to contain more agricultural and manual training. Over 100 students, chiefly teachers, are enrolled in a correspondence course in agriculture, and a four-week course at the college in farm machinery enrolled about 120 students. A special officer has been appointed for extension work, which is carried on in various forms, including corn and strawberry contests for children in different parts of the State.

The publications received from this station during the fiscal year included Bulletins 69, Foods and food products, whisky and other beverages, and drugs and medicines; 70, Paints and their composition; 71, Flax culture; 72, Bleaching of flour; 73, Fattening steers on barley and rejected wheat; 74, Hints to homesteaders; and 75, Cereal crop experiments; Special Bulletins 2, A warning regarding the use of chemical preservatives in meats; 3, Pure food, pure drug, formaldehyde, Paris green, and paint laws; and 4, Pure food, drug, and paint laws; an index number containing an index for Bulletins 48 to 68, and a list of the bulletin publications; part 2 of the Annual Report for 1904; and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15, 000. 00
United States appropriation, Adams Act.....	7, 000. 00
State appropriations.....	7, 500. 00
Individuals.....	1, 500. 00
Farm products, including \$500 from substations.....	1, 143. 49
Live stock.....	3, 248. 88
Miscellaneous .....	1, 177. 09
Total.....	36, 569. 46

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the North Dakota Station is being energetically prosecuted and, with the aid of the State, is being made to cover more fully the agricultural interests of the regions in which its work lies.

## OHIO.

## Ohio Agricultural Experiment Station, Wooster.

C. E. THORNE, M. S. A., *Director*.

The work at the Ohio Station has been continued upon the comprehensive scale hitherto reported. The department of forestry has been organized and work has been begun in several localities. During the past year fully 500,000 trees, chiefly hardy catalpa, black locust, mulberry, and Osage orange were distributed to about 500 farmers and over 1,000 acres were planted by them according to directions sent out by the station. At present the chief problems under consideration by the station are the care of the wood lot and the growing of wind-breaks, but planting for various purposes and studies of the rate of growth under different conditions are to be taken up. A tract of several hundred acres of natural forest belonging to the State boys' industrial school has been put under the care of the station and will be used in studies of the value of second-growth timber. A State appropriation of \$5,000 is available for the experimental work in forestry.

A department of animal nutrition has been established under the direction of E. B. Forbes, formerly of the Missouri University and Station, and a laboratory has been fitted up in one of the main buildings. The principal studies for the present will be of the rôle of phosphorus in animal nutrition. A study is also in progress at the station of the phosphorus supply in various soils and crops, and the two combined are planned to form a comprehensive investigation of phosphorus in the plant and animal, as an Adams-fund project.

The station also has projects under the Adams fund on the rôle of heredity in the improvement of cultivated plants and the rôle of lime in the soil. These projects are important at the present stage of the station's work, and the facilities offered for thorough investigations are exceptionally good. Particular attention is given to the leaching of soils and the variation of phosphoric acid and nitrogen in crops where the plats had received different fertilizers. Between 500 and 600 samples of soils were tested as to lime content during the year. A greenhouse 28 by 56 feet has been constructed for use in pot cultural trials.

The department of animal husbandry and dairying has carried on work in feeding hogs, cattle, and horses and is recording the individual milk yields of the different cows in the station herd. In the feeding experiments with hogs the value of supplementary feeds, such as tankage, middlings, skim milk, and soy beans with corn, their proper proportions in the ration, and light versus heavy rations are being studied. Attention is also being paid to the economy of meat

production under the various rations. The principal investigation with cattle is in feeding silage, and comparisons have been begun of the relative value of corn and oats for work horses. In conjunction with the veterinarian feeding tobacco leaves to lambs is being tried as a remedy for stomach worms.

In the department of agronomy a large number of breeding experiments have been conducted, chiefly with corn, but also with wheat, oats, and alfalfa. With corn the relation to total yield of length, shape, and percentage of grain, the composition of the grain, the effect of fourteen years' fertilizing, and the merits of pedigree stock are being considered. Some crosses of corn were obtained which yielded 78 bushels per acre, as compared with 71 bushels for field selected stock and 63 bushels for inbred ears. The progeny of individual mother plants of wheat and oats are being studied in duplicate plats and similar work is being carried on with alfalfa to secure seed-producing strains, and with clover and soy beans. In connection with these studies between 6,000 and 8,000 protein determinations were made of the various kinds of grain.

In horticulture the lines of work are much as for the previous year and include both greenhouse and field trials with an assistant in charge of each branch. In the greenhouse, improvement breeding with cucumbers, tomatoes, and lettuce is in progress, and breeding with wheat, corn, and potatoes is being conducted in the field. Tests are being made of a number of the so-called improved strains of orchard fruits and spraying experiments are being conducted on an extensive scale.

Test orchards are being established in different parts of the State to study fertilizers, cover crops, mulching, methods of planting, dwarf stock, and nut production.

The botanist is studying a number of plant diseases and is conducting experiments in tobacco, wheat, oats, and corn hybridization. Soil treatment for diseases in the greenhouse and seed bed is being investigated, and in this connection the occurrence has been noted of a root rot of tobacco in the seed bed which is due to the fungus *Thielavia basicola*. A study of clover anthracnose has revealed a second fungus, which is probably more destructive than the *Colletotrichum*. A hitherto undescribed wilt disease of wheat, which caused the destruction of 5 per cent of the plants in some of the permanent plats is reported, and trial is being made of some modified forms of Bordeaux mixture used in spraying grapes.

Entomological work has dealt especially with the grape berry moth, peach borer, codling moth, radish and cabbage maggot, San José scale, and various shade-tree insects and methods for their control. Some very favorable results have been obtained in combating the codling moth and the grape berry moth by spraying, the

injury in each case having been reduced in some badly infested orchards to less than 1 per cent.

The extension work of the station is conducted chiefly through a department of cooperative experiments, which is in correspondence with several hundred farmers scattered throughout the State. The object of this department is to interest farmers in experimental work through small cooperative variety tests and fertilizer trials and to encourage the establishment of more systematic methods on the farm. The Office of Farm Management of this Department is cooperating in the latter work. The department of cooperative experiments, which is supported entirely by State appropriations, is believed to be of great assistance in establishing closer relations between the station and its constituents.

The publications received from this station during the past fiscal year comprised Bulletins 171, Orchard culture; 173, Blighting of field and garden peas, chiefly due to seed infection, Powdery mildew of the pea; 174, Potato investigations; 175, A second Ohio weed manual; 176, Meteorological summary; 177, The Hessian fly; 178, The strawberry test plot; 179, Fattening range lambs; 180, Renewal of old orchards; and 181, Alfalfa in Ohio; Circulars 55, Dependable fruits; 56, A visitor's guide to the more important features of the station's work in 1906; 57, Soil treatment for the forcing house, The control of Rosette (*Rhizoctonia*) in lettuce and tomatoes and of Nematodes in crops grown under glass; 58, The early and late blights of potatoes and how to combat them; 59, Soil treatment of tobacco plant beds; 60, Soluble oils as destroyers of San José scale; 61, Score card for dent corn; 62, Farmers' institutes; 63, The grape berry worm; 64, Dying of bearing grapevines, Localized stem blight in Ohio vineyards; 65, The spring cankerworm; 66, Corn breeding and registration; 67, The value of individual records of dairy cows; 68, Treatment of cooperative forestry plats; 69, The use of manure as a summer mulch in vegetable forcing houses; and 70, the paraffined wire-basket method of soil investigation of the Bureau of Soils, United States Department of Agriculture; and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	5,514.02
Balance from previous year, Adams Act.....	1,485.98
State appropriation, including balance from previous year.....	89,231.49
Farm products, including balance from previous year..	12,777.91
Miscellaneous, including fees.....	2,046.66
<b>Total .....</b>	<b>126,056.06</b>

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The extensive development of various lines of investigations at the station has been made possible by the generous aid given by the State. The appreciation of the station's work is shown by the demands upon its demonstration and extension department, and the results of the scientific investigations are quickly brought home to the people most concerned. The sound policy of taking up investigations that will require a long period of time to complete, but whose results will be far reaching in application, can not fail to be ultimately of great credit to the station.

#### OKLAHOMA.

Oklahoma Agricultural Experiment Station, *Stillwater*.

Department of Oklahoma Agricultural and Mechanical College.

W. L. ENGLISH, B. S., *Director*.

The year at the Oklahoma Station has been one of considerable reorganization. In September, 1906, the director was succeeded by the present incumbent and the resignation of the agriculturist was followed by the discontinuance of that department and the subsequent establishment of departments of agronomy, animal husbandry, and dairying in its stead. Since the close of the year the admission of Oklahoma to statehood has under the new constitution vested the control of the college and station in the State board of agriculture instead of the previous board of regents. The policy of the station has, however, undergone little change, and the work has made considerable progress, especially as to the various projects under the Adams Act.

The completion of Morrill Hall, the new agricultural building, has provided new quarters for the administrative officers and for most of the departments of the station, including the chemical laboratory, which has received new equipment. A two-story horse barn has been built for the breeding and feeding work, a cement storage cave has been constructed for horticultural work, and a laboratory and storage room has been fitted up for seed testing, which has been taken up and found of great service to farmers.

Some very desirable tracts of land were assigned to the station on the new college farm. These have been laid out into permanent plats for variety and cultural tests with wheat, Kafir corn, castor beans, cotton, broom corn, sorghum, barley, oats, spelt, soy beans, and cowpeas.

The station has confined itself to four projects under the Adams fund, namely: Factors affecting the setting of fruit on the tomato

under semiarid conditions; a study of the qualities of drought resistance in corn, and in relation to breeding corn for regions of deficient rainfall; artificial impregnation in animal breeding; and effect of cotton-seed meal and other highly nitrogenous feeds on prepotency. The investigations in these lines have been started in an efficient manner and promise important results.

The distribution of roots of Bermuda grass to farmers was again continued, and nearly every town in the State has now been reached in this way. It is believed that the distribution has been of great value in bringing the station into touch with its constituents.

Other work of the station has included studies of the value of cowpea hay, prairie hay, Bermuda hay, and alfalfa for milch cattle, experiments in pasturing hogs on sorghum, cowpeas, and peanuts, demonstration of commercial dairying, the relative merits of composite versus individual sampling of milk, studies of the bacterial content of cream handled in different ways and of the root tubercle organism of certain legumes, acclimatization work with peaches, and the distribution of blackleg vaccine. Entomological work has included an extensive nursery and orchard inspection and a study of problems relating to the cotton boll weevil, San José scale, codling moth, and green bugs. The chemist has also had much inspection work, this now including feeding stuffs and fertilizers, and in addition he has studied the variations in available fertilizer constituents in wheat soils plowed to different depths.

Several members of the staff assisted in farmers' institute work during the year. A short course held at the station was an unprecedented success with over 500 farmers in attendance. The chief topic of discussion was the agricultural education of the farmer, a subject in which a great deal of interest is being manifested in Oklahoma. Under the new State constitution the legislature is to provide for the teaching of the elements of agriculture, horticulture, stock feeding, and domestic science in the common schools. The college has recently established a two-year correspondence course covering essentially the work of the school of agriculture and domestic science, except as to the practical phases, with a view to preparing teachers for this work.

The publications received from this station during the year included Bulletins 71, Alfalfa; and 72, Tests of dips as lice killers; and the Annual Report for 1906, together with several press bulletins.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000. 00
United States appropriation, Adams Act.....	2,000. 00
Balance from previous year, Adams Act.....	5,000. 00
State appropriation .....	2,500. 00
Miscellaneous .....	4,338. 42
<b>Total .....</b>	<b>28,838. 42</b>

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The Oklahoma Station made substantial progress during the year in improving its equipment, enlarging its working force, and extending the scope and increasing the efficiency of both its practical and its scientific work. This was in large measure due, aside from increased Federal aid, to the fact that, although there was considerable change in organization and personnel, continuity of policy was in the main preserved.

#### OREGON.

##### *Oregon Experiment Station, Corvallis.*

Department of Oregon State Agricultural College.

JAMES WITHYCOMBE, M. Agr., *Director.*

At the Oregon Station considerable attention has been given to the bacteriological investigations, some of which are of a somewhat novel sort. Thus, in connection with work on the soft cheeses an attempt is being made to cure and market this product, and perhaps butter as well, in sausage casings. Experiments are also in progress, in co-operation with a cannery in Honolulu, to utilize the waste material of pineapple canneries for a pineapple sirup. The method of canning vegetables devised by the station is being used commercially, and cheese is being put up in this way for Alaskan trade. The station has also had excellent success this year in canning and preserving wild mushrooms.

In connection with the bacteriology of milk, a specific organism is being cultivated for addition to milk to improve the flavor of the cream and butter. Examinations of milk from a milking machine in use at the station indicate difficulty in keeping the machine in sanitary condition unless steam or antiseptics are used for cleansing. An attempt has recently been begun to sterilize milk by means of an electric current.

The studies of the retting of flax have been continued, and an anaerobic organism has been isolated from water imported from Ireland which seems to be the one instrumental in producing fine fiber. Experiments thus far indicate that the organism is effective under Oregon conditions. In studies of fly specks, it was found that these could be a means of dissemination of typhoid fever. A cooperative investigation has been planned with the poultry department to determine the cause of mortality of the embryonic chick in incubator eggs and the cause of weakened vitality of chicks hatched by incubators.

Chemical work has included a number of miscellaneous features, the testing of a volumetric method of determining potash, and the



continuing of the soil studies with special reference to the loss of nitrogen in summer fallowing. Since the close of the year the chemist has resigned to accept the directorship of the food laboratory which has been established at Portland, Oreg., by the Bureau of Chemistry of this Department.

Under the Adams fund the station planned the following investigations last year: Soil-leaching investigations in relation to the effects of calcium and potassium on fertilizing constituents of the soil; study of the changes taking place in steamed corn and vetch silage, due to the process of ensiling and cooking and the destruction of bacteria; study of lupulin and other active principles of hops, including effects of temperature in drying and other factors; pollination of the apple and conditions affecting it; relation of irrigation of fruit trees to bud and wood development, quality of fruit, etc.; study of the action of lime-sulphur spray; gummosis of the cherry; and apple-tree anthracnose. A considerable amount of investigation was carried on during the season under these heads. Several of the lines selected are of special importance under local conditions, and good facilities are presented for their study.

Aside from the station work mentioned and that under the Adams Act, special prominence has been given to enterprises of a cooperative and demonstration nature, including irrigation investigations in cooperation with this Office, and field experiments with improved varieties of peas, variety testing of vetch, potato breeding for disease resistance, and phenological fruit observations with the Bureau of Plant Industry. An irrigation system and pumping plant have been installed, and it is hoped to extend the scope of the irrigation work. New lines of work include feeding and pasture trials with alfalfa for pigs, storage experiments with apples, and variety and cultural work with strawberries—Logan and Phenomenal berries. A good deal of demonstration work is also under way in the department of horticulture, especially in practical orcharding and in that of entomology and vegetable pathology, which is conducting spraying trials for potato and celery diseases near Portland, and with peach fruit spot and apple scab in commercial orchards. An interesting result of the experiments with scab has been to indicate that the lime-sulphur spray may be used as a summer spray, giving fully as good results as Bordeaux mixture and, when used at the proper strength, producing none of the serious injuries accompanying the use of the latter.

The publications received from this station during the fiscal year included Bulletins 89, Dairy school cream-separator tests; 90, Acid soils; 91, Farm practice with forage crops in western Oregon and western Washington; 92, The walnut in Oregon; 93, Orchard management; and 94, The apple from orchard to market; and the Annual Reports for 1905 and 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	2,000.00
Balance from previous year, Adams Act.....	5,000.00
Miscellaneous, including farm crops.....	1,939.68
Balance from previous year.....	399.89
Total .....	24,339.57

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The college has an appropriation of \$50,000 for maintenance for the ensuing year, which is an increase of \$25,000, besides \$15,000 for farm buildings, \$40,000 for shops, and \$65,000 for an addition to the main building or an auditorium. A woman's building with dormitories for 300 students is being erected, at a cost of about \$60,000. New professorships were established at the close of the year in agronomy, poultry husbandry, animal husbandry, and veterinary science, and the president was succeeded by Dr. W. J. Kerr, of the Utah College. Elementary courses in agriculture, mechanic arts, domestic science, and commerce have since been established and the standard of the degree course has been raised one year. There is much interest in the institution in the State.

The Oregon Station has considerably increased its operations and an advance has been made in the thoroughness of its work. Under the new administration of the college and with the increased funds available it is hoped that a more liberal policy toward the station will prevail, to the end that the station workers may be encouraged to use their best efforts to secure substantial results and have the assurance that a strong and consistent policy of management will be maintained.

#### PENNSYLVANIA.

**The Pennsylvania State College Agricultural Experiment Station, State College.**

**T. F. HUNT, D. Agr., D. Sc., Director.**

The year at the Pennsylvania Station was largely a period of reorganization. At its close Director Armsby was succeeded by T. F. Hunt as dean of the college of agriculture and director of the station. Director Armsby, who had been director of the station since 1888, became the head of the newly organized institute of animal nutrition, which is to be conducted as a special research department of the college, affiliated with the station but coordinate with it. The institute has taken over the work with the respiration calorimeter and allied

nutrition investigations hitherto carried on by the station, and for the current year about \$14,000 will be available for its maintenance.

The department of agricultural chemistry has been divided, Dr. William Frear remaining in charge of the experimental and inspection work and C. L. Penny, of the Delaware Station, being added to the staff primarily to take that of instruction. The analytical work connected with the State food inspection for the central part of the State has been assigned to the station in addition to the fertilizer inspection which has been carried on for several years.

The department of agriculture has been divided into departments of agronomy and animal husbandry, and in these and other departments plans have been made for the further differentiation and specialization of college and station work. Since the close of the year five heads of departments and ten assistants have been added to the staff, including, in addition to those already mentioned, an experimental horticulturist, an agriculturist, an extension specialist, a dairy husbandman, a bacteriologist, a plant pathologist, a forester, assistants in dairy and poultry husbandry, and additional assistants in agronomy and chemistry.

Pending the reorganization of the station few new lines of work were undertaken other than those under the Adams Act, for which three large projects were in operation. The first of these is a study of the influence of age and individuality on the metabolism of cattle, to be carried on with the aid of the respiration calorimeter. This is a continuation of a line of investigation which has been in progress for some little time, and considerable progress was made during the year. The other two projects which were started later in the year relate to the influence of the various factors affecting the yield and quality of apples, and soil investigations in connection with the rotation experiments which have been in progress for many years. In both these lines a good beginning was made during the season.

The agriculturist was granted leave of absence from April 1, 1907, to August 1, 1908. His chief work of the year was in continuation of the tests of soiling crops, studies of the value of alfalfa as a forage crop, and variety and fertilizer tests, chiefly with cereals and potatoes. Experiments with poultry were taken up, the economy of meat production by fowls of different types being compared and a study of the influences affecting the fertility of eggs being begun. Considerable additional equipment was provided for the poultry work.

A study of creamery conditions of the State as related to the quality of the product was instituted by the dairyman. Feeding tests of soiling crops supplemented the field tests already noted, and three experiments in fattening steers were made under conditions comprising open sheds versus basement stable, corn silage versus corn stover, and cotton-seed meal versus a commercial feed prepared from distillers'

grains as a source of protein. The milking machine was tested as to the saving of time, the effect on the yield and bacterial content of the milk, the health of the cows, and the length of the lactation period.

Horticultural work consisted mainly of the testing of varieties with some attention to their susceptibility to disease. A portion of this work was in cooperation with the Bureau of Plant Industry of this Department.

The growing of Sumatra tobacco under tents was continued in Lancaster County from the State appropriation of \$4,000 for the purpose. The crop was pronounced by experts the finest yet produced and attracted much attention from buyers. It is believed that the investigations have demonstrated the practicability of the growth of this type of tobacco on the lighter soils of the county and that the industry can be established on a profitable basis. The work of the year also included a study of new varieties of tobacco and experiments in improvement by seed selection of both the Sumatra leaf and the filler type now grown in the county.

The cooperative soil tests with fertilizers arranged by the station have met with general response from farmers, 38 counties being represented last year. To the series originally planned have been added another on the top dressing of timothy hay and a test of the relative values of raw and acid rock phosphate.

About 360 volumes were added to the station library during the year, chiefly relating to animal nutrition and soil chemistry. The mailing list was increased by about 700 names, making the total approximately 18,000.

The publications of the station received during the fiscal year included Bulletins 78, A test of commercial cultures for legumes; 79, Alfalfa as a forage crop for Pennsylvania; 80, A comparison of alfalfa meal and wheat bran for dairy cows; and 81, Commercial feeding stuffs; a revision of Bulletin 71, Relative values of feeding stuffs; and the Annual Report for 1905.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	6,995.41
Balance from previous year, Adams Act.....	4.59
State appropriation.....	8,164.95
Fees .....	13,188.00
Farm products.....	2,187.95
Miscellaneous .....	145.68
Total.....	45,686.58

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

Since the close of the year the new buildings for the college of agriculture described on page 268 have been completed, thereby affording increased facilities to the station.

### PORTO RICO.

#### Porto Rico Agricultural Experiment Station, Mayaguez.

Under the supervision of A. C. True, Director, Office of Experiment Stations,  
United States Department of Agriculture.

D. W. MAY, M. Agr., *Special Agent in Charge.*

The Porto Rico Station has again prosecuted its activities along two general lines—the developing and improving of economic crops already grown in the island and the introduction of crops which promise to be of financial value—and in each material progress is reported. Attention has been paid to the leading crops of the island, sugar, coffee, tobacco, citrus fruits, pineapples, etc.

Experiments with sugar cane have included methods of culture, fertilizing, and plant breeding. The breeding work has been very successful, canes having been grown at the station with nearly double the average sugar content for the island. Some of the more desirable seedlings have been distributed to planters by whom the work is much appreciated. One of the largest sugar companies is actively cooperating in the breeding work, contributing the services of two men for the purpose. A number of leguminous crops are also under trial as green manures to follow sugar cane with the idea of offsetting the injurious effects of continuous culture.

Although the station is not located in what is recognized as the tobacco district of the island, experiments have been carried on with some of the coarser types and the White Burley and Zimmer Spanish which have been introduced have given encouraging results. Studies have been made of the insects affecting the tobacco plant and the means for their control, and the entomologist has discovered a parasite of the tobacco hornworm which has been propagated and distributed among the tobacco plantations. A number of members of the staff have visited the more important tobacco sections for the purpose of advising planters as to the growth and handling of the crop.

The coffee substation at La Carmelita has demonstrated that the yield of the native varieties of coffee can be greatly increased by better cultural methods and these are being adopted to an increasing extent by growers of the vicinity. The varieties introduced by the station are just coming into bearing and preliminary trials of these coffees in the cup indicate that the aroma characteristic of the higher priced Javas can be reproduced under Porto Rican conditions.

Efforts to secure a diversification of crops have been continued. Lowland rice has again given good results and its local production

is being encouraged as rice is now the largest import. In cooperation with the insular government, 100,000 suckers of sisal plants were imported by the station and sold to planters at cost. Previous experiments had shown that an excellent quality of fiber could be obtained from this plant. The station is also growing the fiber used in the manufacture of Panama hats in the hope of encouraging the local production of the raw material which now is imported.

The horticultural work of the station has been largely with citrus fruits and pineapples, attention being directed both to the introduction of desirable varieties and improved cultural methods. The successful shipments of the Cabezona pineapples, which had not been considered adapted to the purpose, have been followed by their export in large quantities. The importance of wind-breaks in the cultivation of citrus fruits has been established. For permanent wind-breaks the planting of leguminous trees is advised, while mangoes are recommended as an economic crop. The station now has about 50 Indian mangoes and it is hoped to begin a distribution this year. Much of the work with fruits has been in cooperation with planters. This has included fertilizer experiments to test the need of fertilizers, in growing leguminous crops in citrus orchards, and extensive spraying demonstrations for scale insects which now constitute the greatest drawback to the industry. The entomologist is also studying insect parasites which are believed to constitute the most effective means of control under the climatic conditions.

The increased Federal appropriation for the present fiscal year has made possible the establishment of a chemical laboratory which was much needed, and a great extension of the work on lines which hitherto could not be taken up. Many general improvements have been made in the station farm, a new stable has been built, and a water supply and pumping plant have been installed. Oscar Loew, Ph. D., of the College of Agriculture of the Imperial University of Tokyo, has been appointed chemist. A new building for laboratory and office purposes and additional men for certain lines of work are much needed.

During the fiscal year the station issued Bulletin 7, Vegetable growing in Porto Rico, and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation.....	\$15, 000. 00
Farm products.....	4, 121. 03
Total.....	19, 121. 03

The outlook for the Porto Rico Station is very bright, and the planters are learning to appreciate more and more the efforts that are being made for their betterment. The calls for assistance are becoming more numerous and the number of visitors to the station from distant sections of the island is rapidly increasing.

**RHODE ISLAND.**

**Rhode Island Agricultural Experiment Station, Kingston.**

Department of Rhode Island College of Agriculture and Mechanic Arts.

H. J. WHEELER, Ph. D., *Director.*

The Rhode Island Station has been considerably handicapped, especially in its investigations under the Adams Act, by the large number of changes in personnel. These have included nearly all of the assistants and the entire staff in animal industry. Dr. B. L. Hartwell has been made chemist, and G. E. Adams, horticulturist, and additional assistants have been provided in plant physiology and poultry breeding.

The station inaugurated investigations upon six projects under the Adams fund, namely: The extent and nature of the influence exerted upon plants by previous growth in the soil of other kinds of plants; the relation of the chemical composition of certain crops to phosphorus and potassium deficiencies of the soil as a means of determining the soil requirement; the influence of sodium salts upon the organic and inorganic constituents of plants; the blackhead disease of turkeys; the influence of nitrogenous feeding stuffs upon the growth of young chicks; and the causes and means of preventing losses of broiler chicks. These lines of work have been planned in a thorough manner and are being actively and systematically prosecuted. Some important results have already been secured.

In the departments of chemistry and agronomy a large amount of field, pot, and water-culture work has been continued on the relation of sodium to potassium in plant nutrition, and the relation of lime to various fertilizers and their effect on plant growth. It has been found that sodium apparently performs certain valuable physiological functions in the plant when the supply of potassium is deficient, and that it may, under certain conditions, conserve the supply of potassium in the soil, its value in these particulars being largely dependent upon the variety of plant. It has also been shown that roasted iron and aluminum phosphate, which from the analyses would appear to have high manurial value, is essentially worthless for certain crops when used on soil practically deficient in carbonate of lime. These experiments are planned on a comprehensive basis and include grasses, corn, potatoes, small fruits, and flowering plants. The station has brought to a close its cooperation with the Bureau of Soils of this Department, but is continuing comparisons of the wire basket method with the pot and field method in fertilizer experiments with soil tests, as well as its rotation experiments.

Poultry investigations also continue to receive special attention. It has been shown that for young chicks the associated mineral matter

of the ration is a most important factor in determining the feeding value of a given nitrogenous concentrate. Experiments with turkeys indicate that infection with the blackhead disease is not transmitted through the egg, but is apparently derived from turkeys and from ordinary fowls, although the latter seldom die of the disease. Poultz housed on disinfected board floors, even in the midst of centers of infection, have been kept practically or entirely free from the disease for many weeks. It is believed that infection can be nearly or wholly avoided with proper handling of the young poultz and that free range remote from a poultry plant furnishes good conditions for their later development. There has also been breeding work with pigeons and some cooperative poultry experiments for egg production. A State appropriation of \$500 was available for fencing, in the turkey experiments, and there has been a considerable increase and improvement in the poultry facilities, including the construction of a special trap nest for turkeys.

The station is carrying on a number of cooperative field experiments in different parts of the State. These are conducted primarily for the purpose of securing material for use in scientific researches now in progress, but they serve incidentally as an aid to the study of the immediate soil requirements in the respective localities. Extension work is being conducted by a special officer of the college, who also gives much time to the gipsy moth campaign. The station participates in the extension work to a limited extent.

The publications received from the station during the year included Bulletins 112, Commercial feeding stuffs; 113, Continuous corn culture; 114, A test of nine phosphates with different plants; 115, Commercial fertilizers; 116, Corn selection; and 117, Analyses of commercial fertilizers; and the Annual Report for 1906.

The income of the station during the fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	4,464.20
Balance from previous year, Adams Act.....	2,535.80
Miscellaneous.....	4,877.90
Total.....	26,877.90

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the Rhode Island Station is being planned and pursued systematically and energetically. Much of the work has a scientific basis and aims at the securing of results of general and permanent value. At the same time the practical problems of the State are not neglected. The consistent policy on which this station is conducted is much to be commended.



## SOUTH CAROLINA.

South Carolina Agricultural Experiment Station, *Clemson College*.

Department of Clemson Agricultural College.

J. N. HARPER, B. S., M. Agr., *Director*.

The South Carolina Station is making steady progress, especially in the more complete differentiation of its work from that of the college. An arrangement has been made whereby the heads of departments are enabled to devote more time to investigations than formerly, and the working schedule has been so altered as to minimize interruptions. Since the close of the year numerous changes in staff have occurred, including the veterinarian, botanist and bacteriologist, animal husbandman and dairyman, and entomologist, but the vacancies have been promptly filled and the various lines of work continued in much the same way as originally planned.

The station has the following projects under the Adams Act: A study of the relations between the soil and the length and quality of staple of cotton; effects of pollen from barren stalks of corn; rice blast; life history and action of the stomach worm; effects of feeding heavy amounts of cotton-seed meal to cows and means of neutralizing them; application of Mendel's law in horse breeding; and contagious abortion in cattle. Work upon some of these projects has been interrupted by changes in the staff. In other lines the work is well under way.

The work under the Hatch Act also covers a wide range, and much of it is of immediate importance to the people of the State. A typical example of this is the investigation of starch manufactured from sweet potatoes. Practical tests of this starch by laundries and cotton mills indicate that it is more elastic than, and superior to, starch from either corn or Irish potatoes. Considerable attention is being given to variety, fertilizer, and cultural trials with field crops, notably in testing the Williamson method of corn culture and in breeding cotton for prolific long and strong staple, about 400 pollinations having been made. Soil inoculation for alfalfa has been tested, and in a study of the best time for sowing alfalfa five cuttings were obtained from seeds sown the previous fall.

In horticultural lines a large number of enterprises are under way. The general problem of proper pruning for South Carolina conditions is being studied with peaches, Scuppernong grapes, and other fruits, and tests are being made of a number of seedling apples. The effect of the length of scion in grafting apples has also been studied, with the results that short scions have proved very much superior to those a foot or more long. The fall planting of onion seed is being

successfully tried, and there are experiments in the culture and training of tomatoes, celery growing, and with other vegetables. A collection of seedling pecans has come into bearing, and their variation from the parent variety is being studied, together with pecan grafting.

In dairying there was a study of the water content of butter, the value of butter cultures, and comparisons of the purity of wash waters. Soil studies were begun jointly by the geologist and director. The station continues to cooperate with this Department, the lines of work including the eradication of the Texas fever tick, tests of fertilizers on rice lands, the use of lime and fertilizer in controlling rice blast, the development of a sweet corn rich in sugar, determining the adaptability of 50 varieties of vetch for the State, and the production of hemp seed.

At the Coast Land substation diversification trials were continued and some remarkable results were obtained from forage crops, notably 6 tons of cured alfalfa hay per acre. An additional substation was established at Summerville, where 300 acres of land has been donated for the purpose by the Southern Railway Company adjoining its lines, the expense of equipment and maintenance to be defrayed chiefly from college funds derived from State sources. About \$5,000 is now being expended in installing a drainage system. Special attention will be given to problems involved in the reclamation of swamp areas and their adaption to farm homes.

The station is carrying on cooperative experiments with farmers in 35 localities and continues to be active in farmers' institute work, the expense of the latter being defrayed by the college. The college is in a satisfactory condition, with an enrollment of over 700, of whom about 250 are taking the four-year course in agriculture. A new dormitory was recently completed to accommodate 100 additional students, but over 300 applicants had to be turned away for lack of room. A central heating plant has been installed which supplies electric power and light to all buildings, and the station has completed a substantial tool house.

During the year thirteen bulletins and three annual reports were received from the station, as follows: Bulletins 118, Gathered cream plants; 119 and 126, Analyses of commercial fertilizers; 121, A preliminary report on the blast of rice; 122, Calf scours: a new method of treatment; 123, Forage crops grown at Coast Land Experiment Station; 124, The Williamson plan of corn culture; 125, Preliminary report on the water content, melting point, and keeping quality of butter; 127, Alfalfa or lucerne; 128, Stock feeding; 129, Improvement of the woodlot; and 130, Methods of eradicating cattle ticks; and the Annual Reports for 1904, 1905, and 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	5,560.12
Balance from previous year, Adams Act.....	1,439.88
Miscellaneous.....	1,402.53
Balance from previous year.....	1,969.19
Total.....	25,371.72

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The reorganization of the station and a greater differentiation of station and college work has made it possible to devote more attention to scientific investigations. With relief from considerable of the routine work, investigations can now be pursued in a more orderly manner and some of the more urgent problems in the agriculture of the State may be solved.

#### **SOUTH DAKOTA.**

**South Dakota Agricultural Experiment Station, *Brookings*.**

South Dakota State College of Agriculture and Mechanic Arts.

J. W. WILSON, M. S. A., *Director*.

The South Dakota Station has improved its equipment by the completion of a veterinary laboratory building, increased its mailing list to about 3,000 names, and extended the scope and substantial character of its work. A department of dairying has been established in charge of C. Larsen, formerly of the Utah Station.

Under the Adams fund the station has investigations in progress on the breeding of a number of field crops for improvement with reference to special points; breeding investigations for the improvement of hardy wild fruits of the Northwest; study of the nutritive value of grains and fodders fed to horses; and histological and bacteriological investigations on lumpy jaw. The work upon breeding fruits has been in progress for a number of years and has proved a very important line. A beginning was made on some of the other projects during the year.

Plant breeding, animal breeding, and feeding problems continue to be the dominant interests at the station. A new line of work is the breeding of swine with the object of producing animals with more hair, in order that they may resist sunburn, which it is claimed is a very important matter in a large section of the West. The horticulturist was on leave of absence much of the year for the purpose of collecting plants in Russia for the Bureau of Plant Industry of this Department, and has imported a considerable number of hardy sorts.

Many interesting breeding experiments with fruits are under way and an assistant is giving special attention to ornamentals.

Toward the close of the year the botanist and entomologist resigned and has been succeeded by E. W. Olive as botanist and Robert Matheson as entomologist. Botanical work has been chiefly in the improvement of grasses and forage plants, in part on the station grounds and in part at the substation at Highmore. A State appropriation has been made of \$2,000 for maintenance and \$8,000 for new buildings at this substation. A bill was also passed conveying lands in three sections of the State for additional substations, and granting the income of 25,000 acres in addition, for their maintenance. It is expected that these substations will be located in the dry-farming region of the State.

The State also appropriated \$2,000 for a food-inspection laboratory, and a systematic inspection is contemplated.

During the year four bulletins were received from this station, as follows: Bulletins 98, Crop rotation; 99, Macaroni or durum wheats; 100, The feeding value of spelt (emmer) in beef and pork production; and 101, Forage plants at the Highmore substation, 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	2,000.00
Balance from previous year, Adams Act.....	5,000.00
State appropriation.....	1,000.00
Miscellaneous.....	2,958.81
<b>Total.....</b>	<b>25,958.81</b>

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the South Dakota Station is being planned and conducted with special reference to the solving of some of the most important practical problems of agriculture in the State. The general conditions attending the work of the station have greatly improved and its outlook is quite encouraging. The limits of its operations are, however, much restricted by lack of funds, and it is very desirable that the State should materially increase its contribution to the support of the station.

#### TENNESSEE.

**Tennessee Agricultural Experiment Station, Knoxville.**

Department of the University of Tennessee.

H. A. MORGAN, B. S. A., *Director.*

The work of the Tennessee Station and the value of systematic agricultural experimentation have received substantial recognition during the past year through the passage by the State legislature of

acts appropriating \$40,000 for the development of a substation in western Tennessee, and \$10,000 for cooperative experiments in the middle section of the State, the work in each case to be under the supervision of the trustees of the university and station. Plans are being made for the purchase of a farm and equipment for the substation, and cooperative work in middle Tennessee has already been arranged with 23 farmers, representing 13 counties and a variety of soil types. For the present the chief object sought will be crop production. Experiments in horticulture are also being inaugurated in the central and western portions of the State, and when fully established will permit of a considerable extension of spraying and culture demonstrations and related lines of work.

A new agricultural building, to cost \$40,000, is under construction for the university. It is to be available in part for the station offices and laboratories, and will provide much-needed facilities.

The station has investigations in progress under the Adams Act upon humus formation; soil biology as related to humus formation; the life history and habits of the North American cattle tick; studies of the hog louse and of the peach borer; and a new anthracnose of clover and alfalfa. The work is carefully planned and has been actively carried on during the year. It has already yielded important results.

In addition to the work on soil fertility under the Adams Act, tests are being made of different phosphates, green manuring, and stable manure, and rotation trials are in progress to test the effect of rotation and of the addition of lime to Tennessee soils. Methods for the more accurate estimation of humus in soil have been worked out. An extensive system of cylinders for testing soils has been devised and large samples of representative soils have been obtained from different parts of the State.

The station has a large amount of miscellaneous work under way, including experiments to preserve the nitrogen in hen manure, to determine the effect of adding finely ground rock phosphate to silage to increase the availability of the phosphoric acid, and analyses of various crops to determine the amount of plant food removed from soil under different conditions. Field tests are being made with corn and various small grains, together with selection work with wheat, oats, and potatoes; variety tests of soy beans, sorghum, fruits, and vegetables; comparative trials of alsike and red clovers and alfalfa, and cultural methods for alfalfa. Some experiments in cotton breeding have been begun, and MacDougal's experiments in injecting chemicals into the ovaries to induce greater mutation have been repeated.

The veterinarian is making a special study of dermatitis due to feeding and grazing on alsike clover, and is cooperating with the

dairyman in studies of the leucocyte content of milk. Bacteriological studies are being made of some swine diseases and roup, a milking machine is being tested, and individual records of the dairy herd are being kept. Some experiments on the cost of production and feeding value of acre plats of corn, soy beans, and cowpeas and their value in restoring soil fertility are attracting much attention and, together with other cooperative work, are of much assistance in awakening and promoting interest in the university and station.

Cooperative work with this Department has been chiefly in cereal investigations, cotton and clover selection, and dairying. As in previous years, members of the staff have participated in farmers' institutes in cooperation with the State department of agriculture.

The university has recently added to its staff an assistant professor of agricultural education and an assistant professor of animal husbandry. The latter is also taking up some station work, and the establishment of a chair of agricultural education is of much benefit to the station, as it relieves the staff of considerable extension work, especially that conducted through the public schools.

The publications received from this station during the fiscal year included Bulletins, Volume 18, No. 3, Alsike clover; and No. 4, The control of insects, fungi, and other pests.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
Fees .....	1,015.00
Farm products.....	7,031.60
Miscellaneous .....	952.40
Total .....	30,999.00

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

Through its investigations and cooperative experiments the Tennessee Station is getting in closer touch with the people of the State than ever before. The results are already apparent in the increased demand for information along all lines of investigation, and the appropriations by the last legislature seem to indicate confidence in the work.

#### TEXAS.

**Texas Agricultural Experiment Station, College Station.**

Department of the State Agricultural and Mechanical College of Texas.

H. H. HARRINGTON, LL. D., *Director.*

The Texas Station was handicapped to some extent during the past year by the absence of a permanent director, changes in staff, and a lack of adequate laboratories, greenhouses, and other facilities. A

unusually large number of projects were planned under the Adams Act. These included investigations in breeding corn, oats, the dew-berry, and the strawberry; study of the tallow weed; life history of nitrogen-fixing bacteria of legumes; a disease of cotton ascertained to be of bacterial origin; soil studies, including nitrifying and other bacteriological properties; studies of certain constituents of feeding stuffs; the digestibility of the individual constituents of ether extract and nitrogen-free extract in feeding stuffs; the nutritive values of Kafir corn, milo maize, and molasses; control of plum curculio on the peach; the southern grain louse; and stomach and bowel worms of cattle. Work on a number of these projects was interrupted by the changes in the force of station workers, and some other lines have been transferred as more appropriately coming under other funds.

Aside from the Adams-fund projects a very positive demonstration has been made of the poisonous effect of fermented cotton-seed meal on pigs, the animals dying in from forty to fifty days when fed 1 per cent of their weight of the cotton-seed meal. A cooperative experiment has been carried on at Clarendon on the feeding value for steers of Kafir corn combined with cotton seed or cotton-seed meal. The State legislature at its last session appropriated a considerable sum for animal husbandry, mainly for the purchase of live stock, but also for improvement of facilities and to aid in cooperative and demonstration experiments in different parts of the State. This increased aid will be of distinct advantage to the station.

A large number of lines of horticultural work are under way, these including, in addition to those already enumerated, breeding investigations with blackberries and studies of the root systems of different grapes, phylloxera-resistant grape stocks, cooperative experiments with fertilizers for potatoes and tomatoes, these showing a general need of phosphoric acid and a sufficiency of potash for these crops in Texas soils, and experiments in cooperation with the Bureau of Plant Industry of this Department in growing onions, figs, and oranges at the Beeville substation and dry-land forage plants at Chillicothe. Considerable work with peaches was also carried on both at the station and the two substations with reference to the cause and prevention of peach failure and as to cultural methods.

Some phases of the plum curculio work, including the occurrence of the insect on wild plums, are being carried on, as are also studies of the distribution of honey plants and their variation in nectar secretion and the preparation of honey vinegar. It is planned to take up the improvement of bees by crossing. These various entomological studies will be greatly facilitated by the construction of an insectary, for which a small fund was provided by the legislature.

The veterinarian has continued his Texas fever investigations as in previous years. Blood inoculation as a protective measure has

been so far perfected that only 5 to 8 per cent of the animals inoculated are lost, about 3 per cent from inoculation fever and the remainder from tick fever following imperfect immunization by inoculation.

As in former years, the station is giving considerable attention to work of an inspection nature. The feeding stuffs and fertilizer inspections involve a large amount of time, but as they are organized on a basis entirely separate from the investigations, they are so conducted as not to interfere seriously with the latter, and they yield about \$25,000 surplus, which is available for college purposes. Some attention is also being given to the examination of seeds, as a result of which great public interest has developed and it is thought that a seed-inspection law will be enacted.

At the last session of the legislature the biennial appropriation for the college and station aggregated \$346,370, by far the largest appropriation in the history of the college. Of this amount \$2,000 was for publications, \$14,000 for the two substations, and the remainder chiefly for repairs and new buildings. The increased appropriation has enabled the college to strengthen much of the work already under way and to establish new departments, especially a department of agricultural extension work. The legislature also made obligatory the teaching of agriculture in the public schools, and the college and station have furnished considerable aid in connection with its introduction.

During the fiscal year thirteen bulletins were received from this station, as follows: Bulletins 78, Feeding fermented cotton-seed meal to hogs; 79, Breeding an early, rapid fruiting, and productive cotton; 80, Peach growing in Texas; 81, Alfalfa seed testing; 82, Maintaining the fertility of rice soils; 83, Nitro-culture and inoculation; 84, Tomato fertilizers at Troupe; 85, Commercial fertilizers in 1905-6; 86, Cattle feeding experiments; 87, The San José scale; 88, Length of life of vines of various species and varieties of grapes, profitableness, and by what diseases seriously affected; 89, Insects of the garden; 90, The feed control in 1905-6; 91, Food adulteration in Texas; and 92, A test of the producing power of some Texas seed corn.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	4,876.91
Balance from previous year, Adams Act.....	2,123.09
State appropriation for substations.....	10,000.00
Miscellaneous.....	1,335.86
Total.....	33,335.86

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.



Since the close of the year the directorship of the station has been combined with the presidency of the college. The former acting director was appointed assistant director in charge of the feed control and farmers' institute work, and W. C. Welborn was appointed assistant director and agriculturist. There have also been a number of other changes in the staff.

The conditions at the Texas Station during the past year, particularly the long delay and indecision as to the choice of a director and inadequacy of equipment, were such as to make it difficult to maintain the highest efficiency in experimental work. Nevertheless the station made considerable progress in enlarging the scope of its work and in putting much of it on a more efficient basis. Additional State funds are greatly needed by the station to enable it to improve its equipment and to extend its operations so as to more adequately meet the practical needs of the large and varied agricultural interests of the State.

#### UTAH.

*Agricultural Experiment Station, Logan.*

Department of the Agricultural College of Utah.

E. D. BALL, Ph. D., *Director.*

The year at the Utah Station may be characterized as a period of agitation and uncertainty, culminating toward its close in the resignations of the president of the board of trustees, who had served in this capacity since the establishment of the institution; the president of the college; the director of the station; and a number of other members of the staff and the governing board. A determined and protracted effort in the legislature to unite the college with the State University, either by consolidation on one site or by means of a joint board with separate maintenance, was unsuccessful, but the appropriations to both the college and station were much reduced.

At the close of the year the entomologist, E. D. Ball, was elected director of the station, and J. A. Widtsoe, a former director, president of the college. New appointments were also made during the year in agronomy, entomology, and poultry farming, and since its close the dairyman has resigned.

In consequence of the many interruptions and general uncertainty as to future policy few new lines of work were inaugurated, but considerable was accomplished in the continuation of those already under way.

The station planned the following investigations under the Adams fund: Studies of soil fertility in an arid climate under both irrigation and dry farming; preservation of barnyard manure and fermentation under different conditions as related to arid climate; special points in the life history of the codling moth; studies of grasshoppers

and certain insects affecting the sugar beet and strawberry; cause of extensive loss of young chicks; conditions determining the egg-laying capacity of fowls and fertility of the eggs, and optimum conditions for artificial incubation in dry climates. Several projects originally outlined were abandoned during the year, and changes in the staff have caused others to be discontinued, at least temporarily.

The irrigation work of the station has continued to be a prominent feature. This included studies of the actual use of water in different typical irrigated districts, the organization of irrigators and improvement of methods of measurement and distribution of irrigation water, experiments in drainage on six tracts in different parts of the State, a study of conditions in the Uinta Reservation with a view to aiding settlers, and a study on the station farm of the relation of irrigation to the yield and quality of wheat, oats, corn, sorghum, potatoes, sugar beets, alfalfa, peas, and onions. As a result of this work, drainage districts are being organized in different parts of the State and much interest is being shown.

The experiments on the arid farms have demonstrated the possibility of raising profitable crops on large areas in the arid region by the use of scientific methods, and large tracts are being taken up and reclaimed, some of which are already beginning to yield good returns.

The poultry plant has been enlarged and improved by the addition of several colony houses and other minor conveniences, and it is proposed to build a much needed incubator house or room for experimental work. In addition to projects under the Adams Act, studies are in progress of the control of the size of eggs and comparisons of cold versus heated houses and of dry versus wet mash as feed.

In the dairy department some experiments were conducted in feeding for milk production. As a means of utilizing beet tops, ensiling with alfalfa hay was found to give excellent results. There were also tests of the advantages of shelter for milch cows and studies of the use of rennet and pepsin in cheese making.

Facilities for work in animal husbandry have been improved by remodeling a part of the barn. Experiments on the cost of finishing steers in Utah have been carried on, in which alfalfa and chopped feed have been largely used, and there have been comparisons of grain (wheat, barley, and oats) rations for sheep and of pasture with and without supplementary feed for pigs.

A new and well-equipped greenhouse has been erected by the college, which will be of much service to the station, as the facilities have hitherto been very inadequate. The horticultural department has been giving some attention to crown gall and other root diseases of plants, pear and tomato blight, variety and fertilizer tests of onions, and trials of ornamental shrubs, and has had supervision of horticultural experiments at the central substation at Lehigh and the southern

substation at St. George. Since the close of the fiscal year a deficiency appropriation of \$12,000 has been granted by the State for the management of these stations.

In agronomy the various lines of cooperation with the Bureau of Plant Industry of this Department have been continued, and some studies of soil fertility have been begun. The growing of alfalfa for seed and of resistant crops for dry farming has received special attention, and at the central substation the study of rotations has been a prominent feature.

The veterinary work has been of a rather miscellaneous character, including the investigation of local outbreaks of disease, the effect on cows and mares of feeding moldy alfalfa, and observations on an unknown disease of lambs and young sheep.

Good progress was made by the station in the publication of accumulated material. During the fiscal year seven bulletins and two annual reports were received, as follows: Bulletins 93, Agricultural reconnaissance of the Uinta Indian Reservation; 94, Summary of pig-feeding experiments at the Utah experiment station, with deductions from the same; 95, Codling-moth work in 1904; 96, Care of milk on the farm and the manufacture of butter and cheese; 97, Report on the southern Utah experiment station; 98, Report on the central Utah experiment station; and 99, Report on irrigation and drainage investigations during 1905-6; and the Annual Reports for 1904 and 1905. An agricultural journal—*Rocky Mountain Farming*—was also published during a part of the year from State funds appropriated for extension and farmers' institute work, but this has since been discontinued.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	6,821.94
Balance from previous year, Adams Act.....	178.06
State appropriation, including substations.....	18,666.16
Farm products, including substations.....	5,424.34
Miscellaneous, including balance from previous year..	2,930.65
Total.....	49,021.15

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The Utah Station suffered seriously during the past year from the uncertainty resulting from agitation regarding changes in heads of the college and station and the proposal to unite the college with the State University. It is earnestly to be hoped that a settled policy, which is so essential to the efficient use of Federal funds provided for advanced scientific work in agriculture, has now been determined upon.

## VERMONT.

**Vermont Agricultural Experiment Station, Burlington.**

Department of University of Vermont and State Agricultural College.

J. L. HILLS. Sc. D., *Director.*

The principal new investigations at the Vermont Station have been those prosecuted under the Adams Act, these embracing projects on the morphology of the potato plant with reference to structure in relation to disease resistance; physiological effects of copper compounds on the potato plant; disease resistance of potatoes to fungus and bacterial maladies; potato diseases, especially early and late blight, wilt disease, and blackleg; root tubercles on legumes; canker of apples; carnation breeding in relation to physiological effect and Mendelian law; anesthesia of dormant plants for forcing purposes; effect of feeding different amounts of digestible protein to cows for a long period on constitution, milk production, offspring, etc.; and studies regarding the nutritive value of milk and conditions which affect it. Some of the studies were not undertaken until near the close of the year; in others considerable progress was made.

Aside from this work there have been studies of moisture control of butter, the underlying principles in ice-cream making, and a survey of the peat deposits of the State. The work in dairy husbandry and dairying has been reorganized and put in charge of a competent expert, who will give his entire time to investigations in these lines. Assistants have been added to the staff in botany and dairying and in connection with a study of disease resistance C. G. Pringle is making a collection of solanaceous plants in Mexico.

The Morgan horse breeding investigations in cooperation with the Bureau of Animal Industry of this Department have been largely transferred to Weybridge, where a farm of approximately 300 acres and equipped with a large modern horse barn has been deeded to the United States for the purpose by Joseph Battell, the secretary of the American Morgan Horse Breeders' Association. An expert in horse breeding has been added to the staff and it is planned to extend the amount of work.

The State has appropriated \$500 annually for a term of five years for the establishment and maintenance of a nursery for the distribution of forest seedlings. This nursery has been located on the university grounds, under the direction of the New York State forester, who has been made consulting forester. There is considerable interest in this work throughout the State.

Morrill Hall, the new agricultural building, was dedicated on December 11, 1907, the State Grange actively cooperating in the exercises. This is a substantial two story and basement structure, costing

about \$60,000. It is to be used mainly for instruction purposes in the college of agriculture, which last year had ten graduates, but a portion will be available for the offices of the director and the dairy husbandman and for laboratories in horticulture and chemistry. The station has also erected a small building for the work in the nutrition of young animals.

Five bulletins were received from this station during the year, as follows: Bulletins 123 and 126, Commercial fertilizers; 124 and 125, Commercial feeding stuffs; and 127, State nursery for forest-tree seedlings. A bulletin issued since the close of the year on the testing of cows has aroused a large amount of interest throughout New England. The main features of the scheme of testing which it outlines were adopted at a recent conference of dairy interests as a practical basis for the formation of cow-testing associations in those States.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000. 00
United States appropriation, Adams Act.....	7,000. 00
State appropriation.....	1,727. 51
Fees.....	2,968. 70
Individuals.....	167. 77
Total .....	26,863. 98

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the Vermont Station has been considerably broadened and strengthened by recent changes in personnel, equipment, and plans. The institution of more scientific and thorough work in dairy husbandry is a matter of much importance to the agriculture of the State. The construction of the new agricultural building is a substantial evidence of the increased interest in agricultural education and research in the university and the State. The general management of this station might be still further strengthened by a more vigorous and progressive policy with a view to securing the more active interest of the State in the station's operations.

#### VIRGINIA.

##### Virginia Agricultural Experiment Station, Blacksburg.

Department of Virginia Agricultural and Mechanical College and Polytechnic Institute.

S. W. FLETCHER, Ph. D., *Director*.

The work of the Virginia Station was interrupted at the close of the year by the resignation of the dean and director, followed by that of the animal husbandman, plat experimenter, agronomist, and my-

cologist. The presidency of the institution also changed. The station occupied its new building during the year, but there was some interruption of the work in moving in and getting settled. These unsettled conditions regarding the personnel and the quarters had a decided effect on the station work, but a considerable amount of progress has been made in inaugurating the new investigations and in continuing those already under way. An experimental greenhouse (fig. 9) was erected for horticultural work and the bacteriological laboratory was completed and equipped.

The following projects under the Adams Act were undertaken: Effect of various factors on the fixation of phosphoric acid by soils; study of soil bacteria, especially in relation to nitrogen-gathering



FIG. 9.—New experimental greenhouses, Virginia Station.

organisms, denitrifying bacteria, and conditions affecting the growth of bacteria in soils; breeding experiments with apples; phenological studies of fruit; effect of special yeasts and cultures in the fermentation of cider; cerebro-spinal meningitis in horses, and pyæmic arthritis in young animals. Good progress was made in a number of lines, in which the work is well under way, but in others little more than a beginning was made. The work has been somewhat interrupted by the changes in the station staff.

Aside from the investigations under the Adams Act the work was mainly a continuation of that of previous years. The veterinarian has taken up a study of the immunity to tuberculosis of calves treated by the von Behring method. The dairyman has compared the rela-

tive skimming qualities of Jersey and Holstein milk, and is studying methods for the restoration of good flavor to cream from tainted milk. The protein value of home-grown versus purchased feed stuffs was compared on the basis of analyses by the chemist, and feeding experiments with steers, dairy cattle, and hogs were brought to a close and the results published.

A special State appropriation was used for horticultural work, chiefly with tree fruits and vegetables and for the tobacco investigations at Chatham and Appomattox. There were also extensive variety, cultural, fertilizer, and breeding experiments with cereals, legumes, corn, and potatoes, and a study of the principal soil types of the State.

Among other enterprises of a popular nature entered into by the station, the director and several members of the staff were charged with the management of the live stock department of the State fair held at Richmond. The station made an exhibit of potatoes, tobaccos, and cereals in the grain and straw, which attracted a great deal of attention. A working dairy was also operated during the fair.

The publications of the station received during the fiscal year were as follows: Bulletins 160, The influence of selected yeasts upon fermentation; 161, Varieties of fruit for the home orchard; 162, Improving the quality of cream from inferior milk; 163, Origin, composition, and utility of fertilizing materials; and 164, Stall feeding versus grazing; and the Annual Report for 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	6,997.95
Balance from previous year, Adams Act.....	2.05
State appropriation.....	5,000.00
Farm products.....	103.65
Miscellaneous .....	628.74
Total.....	27,732.39

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

#### WASHINGTON.

**Washington Agricultural Experiment Station, Pullman.**

Department of the State College of Washington.

R. W. THATCHER, B. S., M. A., *Director.*

The Washington Station has brought to a close a complete soil survey of the State, with chemical studies of the various soil types, an investigation of tuberculosis in poultry, and a study of methods of

combating the codling moth. So successful was the codling-moth work that in four large orchards, located in various sections of the State and aggregating 80 acres of trees, an average of 99.6 per cent of fruit free from worms was obtained.

A tract of 200 acres has been added to the college and station farm, and will be used principally for the experiments in the production of cereals and forage crops. This work is assuming increased prominence and includes plant breeding, subsoiling, and other cultural methods. About 28 improved varieties have been distributed for testing, especially in the drier regions, where alfalfa is also being introduced. Irrigation experiments in cooperation with this Office have been conducted in the Yakima Valley, and the swale land on the station farm which has been deemed impracticable of drainage was tile drained very successfully. Much attention has also been given to dry farming, and three substations have been established with a State appropriation of \$6,500 for the ensuing biennium for experiments in the conservation of moisture and the adaptability of cereals and other crops to dry farming and irrigation conditions.

The substation at Puyallup, which was suspended in 1903 from lack of funds, has been reopened, with W. H. Lawrence, the former assistant botanist of the station, in charge. A State appropriation of \$20,000 is available for this substation, at which, in addition to other work, special attention will be given to plant diseases.

Owing to a new weed law in the State, there has been renewed interest in experiments for the destruction of weeds, and special studies are being made of tumbling mustard, ferns, and a saltbush. The studies of poisonous plants are also being continued, one feature being the feeding of seeds of certain plants to sheep.

The Adams fund investigations related to the improvement of cereals in yield and in chemical composition; soil moisture investigations as related to problems in dry farming; starch production by the potato and its utilization in making denatured alcohol; tomato blight; effect of parasitism on the host insect; spermatophytes and their extermination, especially by means of pathogenic bacteria; and hemoglobinemia in cattle. Several of these projects are of first importance to western agriculture, and thorough investigations such as are planned into the underlying principles will be of much value.

Other lines of station work have included a large number of variety, cultural, and breeding experiments with fruits and vegetables, in part in cooperation with growers. Special attention has been given to potatoes, with which tests of about 80 early and 100 late varieties are in progress, together with cooperative work in breeding for yield, as well as to ascertain their use as a crop to supplant the summer fallow system now in vogue.



An appropriation aggregating nearly \$600,000 was made by the State legislature to the college for the ensuing biennium, mostly for new buildings. A wing to the veterinary hospital for the joint use of the college and station is being erected at a cost of \$11,000, together with a farm barn to cost \$7,000. Besides the grants for substations, \$12,000 was appropriated for additional farm lands and \$10,000 for the farmers' institutes, which have been put on a more definite basis.

During the year a series of traveling dairy schools was conducted by the extension bureau, work being carried on for ten days in each locality visited. A 2-year forestry course has been established in the college, and a chair of farm management is to be added. The work of the college is becoming very popular in the State and the number of students has largely increased.

The publications received from this station during the year included Bulletins 71, Preserving eggs; 72, The chemical composition of Washington forage crops; 74, Two insect pests of the elm; and 77, The codling moth in the Yakima Valley. The station has recently adopted the plan of issuing a series of popular bulletins giving concise summarized statements of the results of experiments for wide distribution among the farmers of the State, and for this purpose the mailing list is being largely increased. Larger bulletins giving full details of experimental data are still to be issued for distribution to other station workers and to interested parties who may request them.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	3,080.11
Balance from previous year, Adams Act.....	3,919.89
Fees.....	1,164.50
Total.....	23,164.50

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

Since the close of the year the directorship of the station has been separated from the presidency of the college, and the station chemist was appointed director to take office September 15, the management of the Puyallup substation, however, still remaining in the hands of the president.

The Washington Station is increasing the extent and breadth of its work so as to meet more fully the varied requirements of the agriculture of the State. The great prosperity of the college with which it is connected is resulting in much benefit to the station, and it is beginning to receive increased State appropriations directly for its use. As a result of this broad expansion of the college the more dis-

tinct differentiation of the management and work of the station from that of the other departments has been found very desirable. It is hoped that conditions will permit the conducting of the station under the separate director on a vigorous and progressive policy. If this is done it is believed that the work of the station on behalf of the agricultural interests of the State will be materially strengthened.

#### WEST VIRGINIA.

**West Virginia Agricultural Experiment Station, Morgantown.**

Department of West Virginia University.

J. H. STEWART, M. A., *Director.*

The work at the West Virginia Station is continuing along much the same lines as in former years, but with some extension as a result of the Adams Act and increased State aid in the publication of bulletins and reports as well as in direct appropriations. For the past year \$2,000 was available from State funds for inspection work and the investigation of insects and fungus pests, and for the current year this is increased to \$10,000. There was also a considerable revenue from fees and farm products, which has allowed of renovation of the station plant, a substantial addition to the office and stable facilities, and the increase of the station herd.

The new lines of work inaugurated by the station under the Adams Act are upon the effect of pressure in the preservation of fruits, vegetables, and milk; snout beetles infesting nuts, their life histories and natural enemies; woolly aphis of the apple, including special points in its life history; studies of apple rot and "frog-eye," and an unknown leaf spot, and the nature of "clover sickness;" factors which enter into the production of sanitary milk; and the causes of mortality among brooder chicks. The bacteriologist left the station during the year, which led to his project being discontinued for the present. In other lines the work is well under way. Special apparatus to furnish pressure of 30,000 pounds or more per square inch has been installed. (Fig. 10.)

Aside from the Adams-fund work and his inspection duties, the chemist has begun an experiment on the effect of pressure on the organisms in the fruit juices in cooperation with the bacteriologist of a canning association. He is also continuing his efforts on the artificial fixation of atmospheric nitrogen through the use of pressure, and has instituted a very complete study of the coals and oils of the State.

The plant disease survey of the State has been continued and an aggressive campaign has been waged in cooperation with the Bureau of Plant Industry of this Department against peach yellows, about

1,200,000 trees being examined. The work of the station in this line has had the hearty approval and cooperation of the leading fruit growers of the State, and is believed to have been very effective in bringing the disease under control. A bulletin was prepared on grapevine root borer, which was doing considerable damage in some sections of the State. There were also studies of San José scale and the life history of moles, meadow mice, and shrews to learn their habits and means for repression.

The farm department is carrying on experiments on the production of forage plants and on crop production, the permanent plats receiving each year the same fertilizers, but with rotation of crops. A

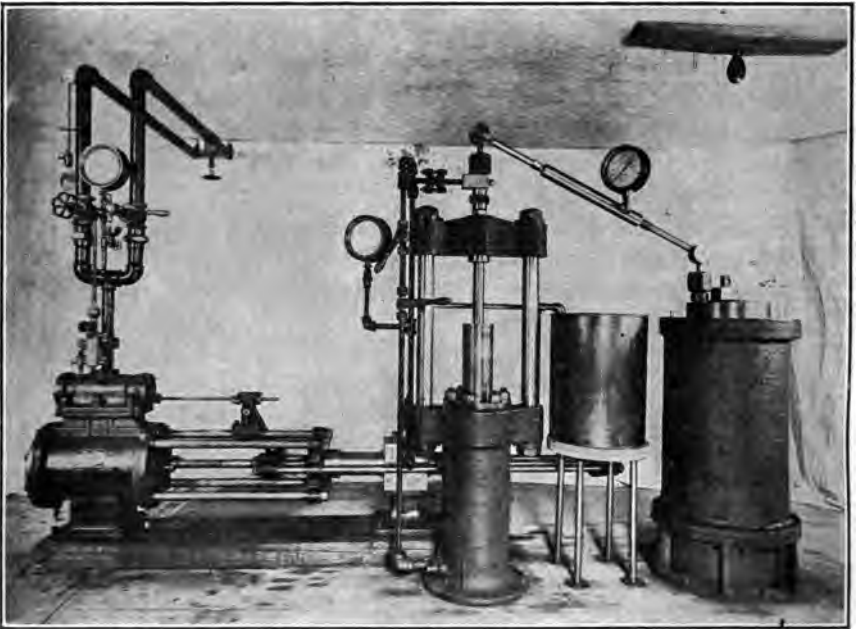


FIG. 10.—High pressure apparatus, West Virginia Station.

commercial dairy is in operation and a complete refrigerating outfit has been installed. The experiments on the Ayrshire-Jersey crosses are being continued with satisfactory results, and feeding experiments are being conducted to test various feeds as supplements to pasturage. In addition to the project under the Adams Act, the poultry investigations have included studies of egg production on a commercial scale, the influence of the age of hens on egg production, and various incubator and brooder problems.

The position of horticulturist has been filled since the close of the year by the appointment of W. M. Munson of the Maine Station. It is expected that special attention will be given to plant breeding in its

relations to pomology. The horticultural work of the year dealt especially with the growing of tomatoes as an adjunct to young orchards. The chief obstacle to orcharding in the State has been the long period of unproductiveness. By growing tomatoes in the orchards this objection is minimized and the orchards are benefited by the cultivation of the hoed crop. In connection with these studies small canneries have been established and numerous problems as to canning management have received attention. In some portions of the State the industry has already become of great importance, the shipments of canned tomatoes from a single point approximating \$750,000 annually.

In addition to the phases of extension and cooperative work already mentioned, the station has tested in a cooperative way with farmers, numerous materials for destroying orchard pests, coal-tar creosote and other remedies for internal parasites of sheep, the use of fertilizers, soil improvement, tuberculin testing of dairy herds, and the introduction of improved varieties of pure-bred poultry. Members of the staff have also engaged to about the usual extent in farmers' institutes and other agricultural gatherings.

In the college a superintendent of agricultural extension work has been added to the staff and the establishment of a department of highway construction has been authorized. A four weeks' good-road school was held during the winter through the cooperation of the State department of good roads, the geological survey, and the inspector of highways. Courses in elementary agriculture and nature study were included in the curriculum of the summer school.

During the year seven bulletins were received from this station as follows: Bulletins 98, Raising chicks artificially; 101, Experiments in the manuring of a meadow; 102, The value of skim milk for laying hens; 103, Occurrence of barium in the Ohio Valley brines and its relation to stock poisoning; 106, Feeding experiments with milch cows; 107, A test of different sprays for the San José scale; and 108, Commercial fertilizers.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$14,999.49
Balance from previous year, Hatch Act.....	.51
United States appropriation, Adams Act.....	4,859.12
Balance from previous year, Adams Act.....	2,140.88
State appropriation.....	2,000.00
Fees .....	8,547.64
Farm products .....	5,251.46
Total .....	37,799.10

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

## WISCONSIN.

**Agricultural Experiment Station of the University of Wisconsin, Madison.**

Department of the University of Wisconsin.

H. L. RUSSELL, Ph. D., *Director*.

At the close of the fiscal year 1907 the dean and director, W. A. Henry, retired from active service after a long period of activity. Under his guidance the Wisconsin Station has been placed in the foremost rank of American stations, and he has also taken a conspicuous part in the investigation of problems relating to animal feeding. Dr. H. L. Russell, the bacteriologist, was elected to succeed him, and Dr. M. P. Ravenel, late assistant medical director of the Henry Phipps Institute for Tuberculosis, Philadelphia, has been elected head of the department of bacteriology in the university and station.

Under the Adams Act the station has undertaken investigations on the importance of mineral constituents of feedings stuffs in the growth and development of farm animals; the milking machine in its mechanical, physical, and hygienic relations; the leucocytes of milk and their sanitary significance; bacteriological and chemical studies in connection with the disposal of creamery sewage; and breeding work on corn, oats, and rye. The last-named project was transferred to other funds at the close of the fiscal year. Several of the other lines of work have already led to important results, and the investigations promise much of interest and value.

A test for casein in milk has been devised by the chemist for rapid determinations. Chloroform and acetic acid of a certain definite strength are added to milk in a special tube and then whirled for seven and one-half minutes in a centrifuge similar to that used for the Babcock test, but revolving much more rapidly. The test checks up to within 0.2 per cent of the results shown by gravimetric analysis. Its use has indicated quite a variation in the casein content of milk of cows of different breeds, and bears out the contention of those who assert that the cheese value of a milk is not measured entirely by its fat content. The casein is considerably higher in relation to the fat in Ayrshires, Holsteins, Brown Swiss, and Shorthorns than in the distinctively butter breeds.

A simple method of determining moisture in butter has also been developed by which weighed samples are subjected to a high steam pressure in an oven, the water content quickly evaporated, and the loss determined by reweighing. As no expensive glassware or chemical reagents are required, the method is believed to be of special advantage to creamery operators.

The chemist is also studying the distribution of phytin in feeding stuffs, particularly as to whether it is combined with the same base

in different cases. It is found that this body occurs quite generally in seeds and cereals. In wheat it is located in the outer layers, but in oats and corn it is distributed through the kernel. Nearly all of the phosphorus is found to occur as phytin and not as phosphates as has been assumed.

Research work in cheese making was carried on in cooperation with the Dairy Division of this Department through Dr. J. L. Sammis. At the close of the year Doctor Sammis was appointed assistant dairy husbandman in the station and has initiated a study of the rôle of acids in the manufacture of Cheddar cheese.

The work on tuberculosis has been continued along the lines of previous years, but materially increased in amount. The dissemination of the disease through infected factory skim milk was studied and is believed to be a large factor in the rapid increase of the disease among hogs. Special emphasis has been laid on extension work with a view to controlling the disease. During the year over 12,000 doses of tuberculin were distributed to farmers and instructions regarding its use were given to about 1,200 former agricultural students, who composed the Wisconsin Agricultural Experiment Association. While under the laws regulating veterinary practice these students are not permitted to collect fees, they are nevertheless rendering great assistance. Post-mortem demonstrations have also been held at a number of fairs, thereby impressing upon thousands of farmers the nature of the disease and the importance of holding it in check.

In animal husbandry the extensive feeding experiments in progress for several years have been continued. The dairy herd was again utilized in a study of the relative merits of high and low protein content in the ration. A novel feature was the feeding under different conditions of several pens of lambs for exhibition and slaughter at the International Live Stock Exposition, where they attracted much attention.

In addition to the plant breeding under the Adams Act, the department of agronomy conducted extensive breeding trials with barley and corn. During the past year over 1,500,000 bushels of barley were grown in the State from a pedigreed strain sent out by the station. The station also has sixteen other pedigreed varieties of barley which have been tested for nine years and are nearly ready for dissemination. The ear-to-row method is being followed in corn breeding, which has increased the average yield of shelled corn from 60 to 98 bushels per acre.

The department of soils has dealt with the improvement of peaty, clay, and sandy soils, and with drainage problems. A new soils substation has been established at Mather on peat underlaid with sand, and experiments are in progress to determine whether the excess of water in the peat can be removed by underdraining the sand.

In horticulture the special work with tobacco has been continued. An improved variety, which has been disseminated in the tobacco districts, has proved much superior as to form of leaf and burning quality to the common type. Studies of certain phases of cucumber forcing have been brought to a close. With potatoes, experiments on blight-resisting varieties have been made at Waupaca, and also trials with home prepared insecticides as a substitute for Paris green, which has been found to be so commonly adulterated that many growers have failed to control potato insect pests by its use. Demonstration work with potatoes was much extended and spraying trials were made on a large scale at various localities in the State.

In the cranberry investigations, which are in close cooperation with the State Cranberry Growers' Association, special emphasis has been placed on insect ravages. Spraying experiments have proved unusually successful for both leaf insects and fruit worms. It is believed that damage from frost can be largely controlled by improved methods of drainage.

The extension and cooperative work of the station, some phases of which have already been noted, has continued to be very large. A clover huller has been procured for free use by farmers in near-by counties as a means of stimulating the growing of clover seed. Butter and cheese scoring exhibitions were begun, the makers sending in samples monthly for scoring and comment. The inspection work is becoming increasingly heavy, now embracing feeding stuffs, fertilizers, official dairy tests, the licensing of stallions for service, and nursery inspection. An act has also been passed by the legislature requiring seed testing, but its operation has been much restricted by the lack of a specific appropriation.

The equipment of the station was much extended by the erection of an agronomy building and a rural engineering building. Descriptions and illustrations of these buildings are given on pages 271, 272.

The publications of the station received during the past fiscal year were as follows: Bulletins 132, The manufacture of whey butter at Swiss cheese factories; 136, Practical directions for preserving native fruits and vegetables; 137, Conditions which affect the time of the annual flowering of fruit trees; 138, Land drainage; 139, Principles and maintenance of soil fertility; 140, Development of factory dairying in Wisconsin, with map showing location of cheese factories and creameries; 141, The horse-breeding industry of Wisconsin; 142, Licensed commercial feeding stuffs, 1906; 143, The spread of tuberculosis through factory skim milk, with suggestions as to its control; 144, Official tests of dairy cows, 1905-6; 145, Relative value of shelled corn and corn meal for fattening pigs; 146, Drainage conditions of Wisconsin; 147, Report on the northern substations for 1906; 148, The pasteurization and the inspection of creamery and cheese factory

by-products; 149, Licensed commercial fertilizers and feeding stuffs, 1907, and 150, Sugar-beet experiments during 1906; and the Annual Reports for 1905 and 1906.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
State appropriation .....	*18,500.00
Fees .....	2,950.00
Total.....	43,450.00

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the Wisconsin Station is well organized and is of a high grade of efficiency, both from a scientific and practical standpoint. The new director is so organizing his office as to keep more closely in touch with the work. The project system has been adopted as a means to this end. There is evidence here that the men are controlled in their work rather than directed. They are stimulated, but are held within bounds. The station is covering a wide field and is doing a great work for the agriculture of the State.

#### WYOMING.

##### Wyoming Agricultural Experiment Station, *Laramie*.

Department of the University of Wyoming.

J. D. TOWAR, M. S., *Director*.

The year at the Wyoming Station has been a period of considerable agitation and uncertainty. A number of changes in staff have taken place, including the resignations of the animal husbandman and the agronomist, and, toward the end of the year, of the director. On the other hand, several new lines of work were inaugurated, chiefly under the Adams Act, and a formal settlement was reached of two questions involving the permanency of the station and its work. By a decision of the United States Supreme Court, the protracted litigation between the university and the Lander Agricultural College as to the disposition of the Federal funds was terminated in favor of the university, which will therefore continue to be the recipient. The university also obtained, through a grant of the legislature, formal possession of the property formerly belonging to the State penitentiary which had been in use for university and station purposes for some time. An appropriation of \$5,000 was made for its equipment for experimental work, and a beginning has been made along this line.

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\* Including \$2,000 for cranberry investigations and \$1,500 for tobacco investigations.



The station planned new investigations under the Adams Act to include alfalfa leaf-spot disease; production of an alkali resistant forage plant by breeding and selection; breeding a perennial shrubby aster and perennial sweetpea; study of certain fungus diseases of Wyoming orchards; root-gall disease of cottonwood and other shade trees; effects of soil treatment and cropping in relation to soil moisture and dry farming; and factors influencing the quality and production of wool. Little was done upon some of these projects and the botanical studies were discontinued or transferred to other funds with the close of the year. The work was further interrupted by the resignation of the director before the plans had been fully put into operation. Special preparations have been made for investigations upon the last two projects, and the facilities of the station seem to offer good opportunity for their successful prosecution.

A wool specialist has been added to the staff in connection with the investigation of the feeding and breeding of sheep for wool, which is in part in cooperation with the Bureau of Animal Industry of this Department and in part an Adams-fund project. Over 300 breeding ewes, mostly high-grade and pure-bred Rambouillets and 6 pure-bred Rambouillet rams, have been obtained for work under range conditions, and an experimental wool-scouring plant has been installed for studies of Wyoming wools and wool scouring.

A new series of dry-farming investigations has been undertaken in cooperation with the irrigation investigations of this Office. There have also been studies of the duty of water as related to a maximum crop of growing barley, the duty of water for peas, and seepage losses, as well as comparisons by means of field plats of the relative cost and value of the furrow flow and check methods for applying water. It has been found that more water is required under hothouse conditions than in the field, that potatoes require less water than other crops experimented with, and that summer fallowing tends to conservation of soil moisture.

An experiment as to the preservation of pitch pine fence posts has been brought to a close, and the results with various treatments have been published in bulletin form. The most effective means of preservation seems to be to apply crude petroleum to the posts 3 feet from the bottom and then to burn off the oil. Posts treated in this way showed no decay whatever after having been in the ground for sixteen years.

Other work has included the continuation of the alkali studies, digestion experiments with native hays, oats, straw, and sweet clover, and feeding trials with pigs and Herefords, in which various combinations of foods locally available were tested.

There has been of late more interest in agricultural instruction in the State, and especially in farmers' institutes, for the maintenance

of which the last legislature appropriated \$2,000. Efforts are also being made to interest teachers in agricultural instruction, and a teachers' institute was held at the university for the discussion of this question.

The publications of this station received during the past fiscal year included Bulletins 69, Digestion experiments with wethers—alfalfa and native hay; 70, Wyoming forage plants and their chemical composition; 71, Some potato diseases, their cause and control; and 72, Duty of water on field peas.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	7,000.00
Farm products.....	4,951.41
Total .....	26,951.41

A report of the receipts and expenditures for the United States funds has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The work of the Wyoming Station has been much hampered during the past year by changes in its staff and uncertainty regarding its future. Some enterprises have, however, been inaugurated which may mean much to the future development of the State, if a strong and consistent policy is worked out and maintained. The station is now in a critical condition and much will depend on the elaboration of good plans of work in the near future.



# THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

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### *Vice-Presidents.*

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E. A. BRYAN, of Washington.

H. H. HARRINGTON, of Texas.

C. D. WOODS, of Maine.

H. C. PRICE, of Ohio.

### *Secretary-Treasurer.*

J. L. HILLS, of Vermont.

### *Bibliographer.*

A. C. TRUE, of Washington, D. C.

### *Executive Committee.*

H. C. WHITE, of Georgia.

W. E. STONE, of Indiana.

J. L. SNYDER, of Michigan.

W. H. JORDAN, of New York.

C. F. CURTISS, of Iowa.

### *Sections.*

Section on College Work and Administration: R. W. STIMSON, of Connecticut, chairman; E. R. NICHOLS, of Kansas, secretary.

Section on Experiment Station Work: C. E. THORNE, of Ohio, chairman; P. H. ROLFS, of Florida, secretary.

## TWENTY-FIRST ANNUAL CONVENTION.

The twenty-first annual convention of the association was held at Lansing, Mich., May 28-30, 1907, in connection with the celebration of the fiftieth anniversary of the Michigan Agricultural College, the proceedings of the third day's sessions of the convention forming a part of the anniversary celebration.

## GENERAL SESSIONS.

The annual address by the president of the association, L. H. Bailey, of New York, discussed the subject of the State and the farmer. (See p. 254.)

The report of the executive committee briefly reviewed the events of the year, among which were the increase of funds to the land-

grant colleges through the passage of the Nelson amendment to the current agricultural appropriation act and the designation of the colleges as depositories of public documents. The report stated that it had been deemed best to attempt no action relative to the establishment of a national university at Washington, as no further effort had been made by the National Association of State Universities or others interested. Through its chairman, H. C. White, the committee has endeavored, at a conference held November 21, 1906, to secure the admission of the land-grant colleges to the benefits of the Carnegie Foundation for the Advancement of Teaching. While the views of the board of trustees were then adverse to the admission of these institutions, final decision was to be deferred until another conference had been held. Action relative to the occasional meeting of the association with the National Education Association, for the discussion of the pedagogics of agriculture and allied subjects, was deferred in view of the efforts being made to secure the establishment of a department of rural education in that association. The chairman of the executive committee was authorized to conduct further negotiations with the officers of the Carnegie Foundation.

The association adopted a resolution of appreciation of the services of Senator Knute Nelson, of Minnesota, in securing the increased appropriation to the land-grant colleges.

The report of the bibliographer, A. C. True, took the form of brief historical notes on some early agricultural text-books and on the beginnings of agricultural education in this country. In the discussion that followed it was urged that a complete history of the agricultural educational movement in this country should be brought together at an early date, and a committee, consisting of A. C. True, E. Davenport, and W. A. Henry, was appointed to take charge of the matter.

The report of the committee on instruction in agriculture, presented by A. C. True, as chairman, stated that series of exercises for elementary instruction in agronomy had been prepared and published.<sup>a</sup> A more advanced course in agronomy, supplementing this and designed for the use of secondary schools of relatively high grade, has been made ready for publication.<sup>b</sup> The preparation of similar elementary and secondary courses in animal production and related topics and college courses in rural engineering and home economics is under consideration.

The report of the committee on graduate study, submitted by M. H. Buckham, stated that preliminary arrangements had been

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<sup>a</sup> U. S. Dept. Agr., Office Expt. Stas. Bul. 186.

<sup>b</sup> U. S. Dept. Agr., Office Expt. Stas. Circ. 77.

made to hold the next session of the summer school at Cornell University, with the cooperation of the New York State Experiment Station, in the summer of 1908, with A. C. True as dean. Special attention is to be centered on the interrelations of the chemical and biological groups of studies. The value of the school to both the educational and investigational work of the association was pointed out, together with the necessity for adequate financial support. It was voted to continue the present system of asking contributions from the several colleges, and the amount was fixed at \$25 for each institution, payable on or before July 1, 1907, and annually thereafter. (See also p. 255.)

K. L. Butterfield, reporting for the committee on extension work, summarized the replies received from 42 institutions, representing 39 States, to a circular of inquiry regarding the status of the extension teaching in agriculture in each case. (See p. 255.)

The report of the committee on station organization and policy presented by its chairman, E. Davenport, strongly urged that all the stations use the "official" mailing list prepared by this Office. The report also called attention to the fact that the unprecedented demand for men trained in agricultural subjects is resulting in the appointment to important positions of young men practically fresh from graduation, and necessarily deficient in their training, with the result that the responsibilities of these positions and the salaries attached are out of all proportion to either the experience or the scholarship of the men appointed. The committee expressed its appreciation of the work of this Office in furthering the interests of agricultural experimentation and favored its extension.

The commission on organization and policy in agricultural research, appointed in accordance with a resolution adopted at the last convention, made a brief preliminary report of progress through its secretary, W. H. Jordan. It is expected that a final report will be made to the association at its next convention.

Resolutions advocating the continuance of the investigations on human nutrition which have been carried on by this Office for several years past, and indorsing the establishment by the Pennsylvania State College of an institute of animal nutrition as an independent department of research were adopted. The executive committee was instructed to take such action in each case as would aid in securing permanence to these lines of work.

Robert Wallace, professor of agriculture and rural economy in the University of Edinburgh, at the invitation of the association gave an interesting talk on the live stock of Great Britain, prefacing this with remarks on agricultural education in the United Kingdom.

Efforts to secure national aid to the land-grant colleges for the establishment and maintenance of forestry courses through the re-

ceipts from forest reserves was advocated by S. B. Green and G. E. Fellows. The importance of more adequate State aid in such matters was emphasized by E. Davenport.

Several speakers expressed their appreciation of the usefulness of the Experiment Station Record to the station and college workers, and urged that provision be made, by appropriation or otherwise, for more detailed abstracts than are practicable under present conditions.

The third day's session of the convention, which was held at the Michigan Agricultural College, was devoted to three addresses dealing with separate phases of the work of the land-grant colleges—agricultural education, engineering education, and research.

The first of these, The Development of Agricultural Education, by Elmer E. Brown, United States Commissioner of Education, included a brief summary of the evolution of the agricultural colleges and allied agencies, together with an interpretation of the agricultural education movement and its outlook. (See p. 256.)

In a paper on The Development of Engineering Education in the Land-Grant Colleges, W. E. Stone pointed out that engineering instruction developed in these institutions more rapidly than the agricultural phases, partly because it was more readily reduced to concrete pedagogical form, and partly because of the extraordinary demand for such instruction. He traced the lines and consequences of the development of this phase of education.

In his address upon The Authority of Science, W. H. Jordan explained that such authority is derived from severely tested and verified knowledge; and he outlined the conditions which determine the reliability of scientific deductions, factors which have been inimical to agricultural research of the true type in this country, and the need of broader conceptions and greater freedom.

He pointed out that much of the so-called agricultural inquiry in this country has not been so much research as the exploitation of existing knowledge, obtained in many instances from foreign sources, without amplification or adaptation. "Although important new truths have been brought to light, our efforts at inquiry have neither produced results nor commanded the respect of the scientific world to an extent commensurate with the generous means applied. During the past twenty-five years we have been busy, instead, with much agricultural speaking and writing." As a result "we are now seeing with greater distinctness every year that the more complex and more important problems of agriculture are still unsolved, and that because of this our utterances to the practical man are still lame and halting." The investigator was pointed to as the primary consideration in scientific research, and he was considered from the standpoints of his personal equipment for investigation, his motives or point of view, and his environment.

An earnest appeal was made to the colleges and universities to give more attention to the training and preparation of men for this work, and the inculcation of the proper spirit and point of view. "It is a serious question whether we are right in our educational plans when we place almost the entire emphasis upon the commercial or business side of agriculture and the industries, or whether in doing this we are promoting the highest utility of agricultural and industrial education." Without an increase in the supply of men he declared that increased funds can not be efficiently employed, and further agricultural development will inevitably be checked.

#### **SECTION ON COLLEGE WORK AND ADMINISTRATION.**

The programme of this section dealt largely with problems relating to administration and curriculum, and included discussion of the selection and retention of an efficient teaching force, the preparation of instructors for teaching the elements of agriculture and the mechanic arts as authorized by the Nelson amendment, extension work in agriculture, and the value and importance of the short practical course. (For fuller account of this section's proceedings see p. 257.)

#### **SECTION ON EXPERIMENT STATION WORK.**

The general subject of the papers presented before this section was Present Day Problems in Plant Pathology. Under this heading M. V. Slingerland considered The More Urgent Problems in Insect Control, the problems being classified as national and local. It was stated that owing to the vastness of the field in this country, and the manifold demands made upon the entomologist for various kinds of work, few, if any, of the insect problems had been worked out to the entire satisfaction of entomologists and agriculturists.

In a paper on Progress in the Control of Fungus and Bacterial Plant Diseases F. C. Stewart expressed the opinion that more progress in the actual control of fungus diseases had been achieved during the past twenty-five years than in all previous time, but that much remains to be done on the causes of the diseases, in the tracing of the life histories of many of the fungi, and especially in devising effective means of control. He thought that ignorance of the methods of practical agriculture, coupled with a disinclination to make field experiments on a commercial scale during a series of years, had been responsible for many impracticable recommendations by plant pathologists. Cooperation of the economic entomologist, the bacteriologist, the agriculturist, the horticulturist, or the chemist in the investigation was considered as often very essential.

In a discussion of this paper the need for cooperation by investigators in different States in the study of those diseases which appear



only at intervals in a given region, such as potato blight and rot and the downy mildew, was suggested. A similar opportunity was pointed out in connection with the introduction of resistant strains and varieties from other localities.

The Relation of Cultural Methods to Plant Diseases was discussed in a paper by G. E. Stone.

The topic for general discussion was The Duplication of Work in Agricultural Investigation, led by papers by H. T. French and H. Garman.

The special topic decided on for the next meeting was Milk Production, including Sanitation; and the subject for general discussion, The Relation of the Experiment Station to Instruction Work, with Special Reference to Its Popular Phases.

# STATISTICS OF LAND-GRANT COLLEGES AND AGRICULTURAL EXPERIMENT STATIONS, 1907.

By Miss M. T. SPETHMANN.

The following statistical statements relate to the institutions established under the acts of Congress of July 2, 1862, and August 30, 1890, most of which maintain courses of instruction in agriculture, and to the agricultural experiment stations, which, with few exceptions, are organized under the act of Congress of March 2, 1887, and are conducted as departments of the institutions receiving the benefits of the land-grant act of July 2, 1862. These statistics have been compiled in part from replies to a circular of inquiry sent out from the Office of Experiment Stations and in part from the annual reports of the presidents of these institutions made on the schedules prescribed by the Commissioner of Education. Tables showing the annual disbursements on account of the acts of Congress of March 2, 1887, August 30, 1890, March 16, 1906, and March 4, 1907, prepared from figures furnished by the Departments of the Treasury and the Interior, are also included. Owing to the complex organization of many of the institutions, it is impracticable to give exactly comparable statistics in all cases, and in some instances the data furnished are incomplete.

## SUMMARY OF STATISTICS OF LAND-GRANT COLLEGES.

Educational institutions receiving the benefits of the acts of Congress of July 2, 1862, and August 30, 1890, are now in operation in all the States and Territories except Alaska, Hawaii, and Porto Rico. The total number of these institutions is 65, of which 63 maintain courses of instruction in agriculture. The aggregate value of the permanent funds and equipment of the land-grant colleges and universities in 1907 is estimated to be as follows: Land-grant fund of 1862, \$12,744,466.18; other land-grant funds, \$4,034,014.60; other permanent funds, \$17,581,866.90; land grant of 1862 still unsold, \$4,858,110.77; farms and grounds owned by the institutions, \$11,055,844.42; buildings, \$33,363,261.10; apparatus, \$2,845,698; machinery, \$1,994,638.30; libraries, \$3,062,622.95; live stock, \$450,211.83; miscellaneous equipment, \$4,243,224.01; total, \$96,233,959.06. The income of these institutions in 1907, exclusive of the funds received from the United States for agricultural experiment stations (\$998,800), was as follows: Interest on land-grant funds of 1862, \$741,820.56; interest on

other land-grant funds, \$131,561.10; United States appropriation under act of 1890, \$1,200,000; interest on endowment or regular appropriation, \$270,008.50; State appropriation for current expenses, \$4,561,496.90; State appropriations for buildings or for other special purposes, \$3,011,928.86; income from endowment, other than Federal or State grants, \$747,803.44; tuition fees, \$1,021,723.05; incidental fees, \$769,985.20; miscellaneous, \$2,104,211.13; total, \$14,560,538.74. The value of the additions to the permanent endowment and equipment of these institutions in 1907 is estimated as follows: Permanent endowment, \$1,303,030.26; buildings, \$2,980,700.87; libraries, \$203,917.50; apparatus, \$299,401.44; machinery, \$143,466.71; live stock, \$96,390.87; miscellaneous, \$242,841.84; total, \$5,269,749.49.

The number of persons in the faculty of the colleges of agriculture and mechanic arts was as follows: For preparatory classes, 482; for collegiate and special classes, 2,617; total, counting none twice, 3,518. In the other departments the faculties aggregated 1,627, making a grand total of 5,145 persons in the faculties of the land-grant institutions.

The students in 1907 in the colleges for white persons were as follows: (1) By classes—Preparatory, 5,437; collegiate, 24,382; short course or special, 6,565; postgraduate, 575; other departments, 23,107; total, counting none twice, 59,485. (2) By courses: *Four-year*—Agriculture, 3,450; horticulture, 174; forestry, 114; veterinary science, 200; household economy, 1,047; engineering, 16,330. *Shorter than four years*—Mechanic arts, 669; agriculture, 3,532; horticulture, 156; forestry, 79; dairying, 559; veterinary science, 305; household economy, 550; two-year teachers' courses in agriculture, 83; summer school of agriculture for teachers, 925; military tactics, 16,048.

The students in colleges and schools for colored persons were as follows: (1) By classes—Preparatory, 4,676; collegiate, 816; short or special, 180; other departments, 1,036; total, 6,708. (2) By courses—Agriculture, 1,659; industrial courses for boys, 2,285; industrial courses for girls, 3,801; military tactics, 1,646.

The graduates in 1907 were 5,798, and since the organization of these institutions, 72,724. The average age of graduates in 1907 was 22 years and 2 months. The total number of volumes in the libraries was 1,993,639, and the total number of pamphlets, 561,377. The total number of acres of land granted to the States under the act of 1862 was 10,320,842, of which 769,588 are still unsold.

### SUMMARY OF STATISTICS OF THE STATIONS.

Agricultural experiment stations are now in operation under the act of Congress of March 2, 1887, in all the States and Territories and under special appropriation acts in Alaska, Hawaii, and Porto Rico.

In Connecticut, New Jersey, New York, Hawaii, Missouri, Alabama, Louisiana, and North Carolina separate stations are maintained wholly or in part by State funds. A number of substations are also maintained in different States. Excluding the substations, the total number of stations in the United States is 61. Of these, 55 receive appropriations provided for by acts of Congress.

The total income of the stations maintained under the acts of 1887 and 1906 during 1907 was \$2,334,671.90, of which \$1,056,000 (Hatch fund \$720,000, Adams fund \$336,000) was received from the National Government, the remainder, \$1,278,671.90, coming from the following sources: State governments, \$770,016.34; individuals and communities, \$15,360.57; fees for analyses of fertilizers, \$119,470.77; sales of farm products, \$169,553.23; miscellaneous, \$204,270.99. In addition to this the Office of Experiment Stations had an appropriation of \$254,862, for the past fiscal year, including \$18,000 for the Alaska experiment stations, \$20,000 for the Hawaii Experiment Station, \$15,000 for the Porto Rico Experiment Station, \$20,000 for nutrition investigations, \$122,200 for irrigation and drainage investigations, and \$5,000 for farmers' institutes and agricultural schools. The value of the additions to the equipment of the stations in 1907 is estimated as follows: Buildings, \$134,273.33; libraries, \$22,366.22; apparatus, \$49,841.50; farm implements, \$28,852.97; live stock, \$64,124.71; miscellaneous, \$88,204.03; total, \$387,662.76.

The stations employ 1,098 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 55; assistant and vice directors, 18; special agents in charge, 3; chemists, 213; agriculturists, 61; agronomists, 84; plant breeders, 7; animal husbandmen, 79; poultrymen, 15; horticulturists, 108; farm and garden foremen, 24; dairymen, 61; botanists, 59; plant pathologists, 25; entomologists, 80; zoologists, 5; veterinarians, 37; animal pathologists, 4; meteorologists, 9; foresters, 13; mycologists, 3; biologists, 7; physicists, 6; geologists, 5; bacteriologists, 36; irrigation engineers, 14; agricultural engineers, 6; in charge of substations, 32; secretaries and treasurers, 30; librarians, 16; clerks and stenographers, 76. There are also 61 persons classified under the head "Miscellaneous," including superintendents of grounds and buildings, gardeners, farm mechanics, laboratory and field assistants, etc. Four hundred and eighty-four station officers do more or less teaching in the colleges with which the stations are connected. During the year the stations published 459 annual reports, bulletins, and circulars, which were supplied to over 774,000 addresses on the regular mailing lists. A larger number of stations than formerly supplemented their regular publications with more or less frequent issues of press bulletins and other special publications, and most of the stations report a large and constantly increasing correspondence with farmers on a wide variety of topics.

STATISTICS OF THE LAND-GRANT COLLEGES AND UNIVERSITIES. <sup>a</sup>

Unless otherwise specified, the statistics reported in the tables are for the institutions as designated in the list given below:

TABLE 1.—*Institutions established under the land-grant act of July 2, 1862, and their courses of study.*

[All of the institutions in this list, except those marked with an asterisk (\*), maintain courses of instruction in agriculture.]

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate).	
				Four-year courses and degrees.	Shorter courses.
Alabama.....	Alabama Polytechnic Institute.	Auburn.....	C. C. Thach, M. A., LL. D.	Chem. and agr., civil engin., archi., elect. engin., mech. engin., mining engin., phar., general, chem. and metal. (B. S.).	Aggr., mech. arts (2 yrs.), phar. (2 yrs., Ph. G.), phar. (3 yrs., Ph. C.), vet. med. and surgery (3 yrs., D. V. M.), agr. (1 yr.), summer school for farmers (10 days), Indus. and lit. studies (1 to 4 yrs.).
Arizona.....	Agricultural and Mechanical College for Negroes.	Normal.....	W. H. Council, Ph. D.	Sci. (B. S.), agr. (B. A. S.), mech. (B. M. S.).	
Arkansas.....	University of Arizona..	Tucson.....	K. C. Babcock, Ph. D.	Lit. (Ph. B.), sci., metal., mining engin., civil engin., mech. engin. (B. S.).	Mineralogy and assaying (2 yrs.), prep. (4 yrs.), music.
	University of Arkansas.	Fayetteville....	J. N. Tillman, LL. D.	Aggr. (B. S. A.), mech. engin. (B. M. E.), elect. engin. (B. E. E.), civil engin. (B. C. E.), mining engin. (B. M. E.), chem. engin. (B. Ch. E.), chem. (B. S. C.), lit. and sci. (B. A. and B. S.), music (B. Mus.), normal, art.	Aggr., hort., dairying, elect. engin. (2 yrs.), mech. arts (2 or 3 yrs.), prep. (2 yrs.), agr. (2 weeks).
California.....	Branch Normal College.	Pine Bluff.....	Isaac Fisher.....	Collegiate (B. A.), normal (L. I.), manual training, mech. arts.	Prep. (2 yrs.).
	University of California.	Berkeley.....	B. I. Wheeler, Ph. D., LL. D.	Letters (B. A.), social sci. (B. L.), natural sci., commerce, agr., mech. engin., elect. engin., mining engin., civil engin., chem., sugar technol. (B. S.).	Prep. med. (3 yrs.), agr., animal indus., dairying (6 weeks), nutrition (3 weeks), ent. (4 weeks), vit. (4 weeks), summer session (6 weeks).
Colorado.....	The State Agricultural College of Colorado.	Fort Collins....	B. O. Aylesworth, M. A., LL. D., Litt. D.	Aggr., mech. engin., civil and irrig. engin., elect. engin., general and domestic sci., hort., general sci. for women (B. S.), vet. sci. (D. V. S., 3 yrs.).	Aggr., domestic sci. (2 yrs. of 5 months each), forestry (2 weeks), general agr. (2 weeks).
Connecticut.....	The Connecticut Agricultural College.	Storrs.....	R. W. Stimson, A. M., B. D.	Aggr., home econ. (B. S.).....	Aggr., hort., mech., home econ., nature study (2 yrs., diploma), poultry (1 yr.), summer school for teachers in nature and country life (4 weeks), farm dairying, creamery, pomol. (winter, 12 weeks) poultry (6 weeks), 32 ten-day courses, Aggr. (1 or 2 yrs.), agr. (winter, 10 weeks).
Delaware.....	Delaware College.....	Newark.....	G. H. Harter, M. A., Ph. D.	Clas., Lat. sci. (B. A.), agr., general sci., civil engin., mech. engin., elect. engin. (B. S.), agr. (no degree).	Normal (3 yrs.), industrial (2 yrs.), prep.
	State College for Colored Students.	Dover.....	W. C. Jason, M. A., D. D.	Sci. (B. S.), agr. (B. Agr.), engin. (B. E.)....	

<b>Florida</b> .....	University of the State of Florida.....	Gainesville.....	Andrew Shedd, Ph. D., LL. D.	Lit. (B. A.), gen. sci., agr., mech. engin., elect. engin., civil engin. (B. S.), pedag. (B. A. in Ped.).....	Normal (4 yrs.), agr., mech. arts, pedag. (2 yrs.), summer school for teachers (6 weeks).
<b>Georgia</b> .....	Florida State Normal and Industrial School.....	Tallahassee.....	N. B. Young, M. A.	.....	Normal (2 yrs.), high school, grammar school (3 yrs.), inclua. training through all courses.
<b>Idaho</b> .....	Georgia State College of Agriculture and Me- chanic Arts.....	Athens.....	A. M. Soule, B. S. A.	General sci., agr., civil engin., elect. engin. (B. S.).....	Phar. (2 yrs., Ph. C.), agr., hort., dairying (1 yr.), agr. (12 weeks).
<b>Illinois</b> .....	Georgia State Indus- trial College.....	Savannah.....	R. R. Wright, A. M., LL. D.	Collegiate (A. B.).....	Normal (3 yrs.), industrial prep. (3 yrs.), dairying (winter, 2 months).
<b>Indiana</b> .....	University of Idaho.....	Moscow.....	J. A. MacLean, Ph. D., LL. D.	.....	Prep. (3 yrs.), dairying and hort. (winter, 4-6 weeks), agr. (summer, 6 weeks).
<b>Iowa</b> .....	University of Illinois.....	Urbana.....	E. J. James, Ph. D., LL. D.	.....	Law (LL. B.), surgery (D. D. S.) (3 yrs.), summer school (9 weeks), agr. and do- mestic sci. (2 weeks).
<b>Indiana</b> .....	Purdue University.....	Lafayette.....	W. F. Stone, Ph. D.	.....	Agr. (2 yrs.), agr., hort., animal husb., dairying (winter, 10 weeks), phar. (2 yrs., Ph. G.).
<b>Iowa</b> .....	Iowa State College of Agriculture and Me- chanic Arts.....	Ames.....	A. B. Storms, A. M., D. D., LL. D.	.....	Mining engin., clay working (2 yrs.), prep. (1 yr.), dairying (1 yr.), dairying (16 weeks), corn and grain judging, stock judging, domestic econ., hort. and for- estry (winter, 2 weeks each).
<b>Kansas</b> .....	Kansas State Agricul- tural College.....	Manhattan.....	E. R. Nichols, A. M.	.....	Domestic sci. (2 terms, 12 weeks each), farmers (2 winter terms, 10 weeks each), summer domestic sci. course for teach- ers (10 weeks), farm dairying (10 weeks), dairying (12 weeks), agr. for teachers (summer, 6 weeks).
<b>Kentucky</b> .....	Agricultural and Me- chanical College of Kentucky.....	Lexington.....	J. K. Patterson, Ph. D., LL. D.	.....	Agr. (2 yrs.), prep. (3 yrs.), 3 normal courses (1 yr. each), agr. (winter, 10 weeks), summer school for teachers.
<b>Louisiana</b> .....	Kentucky Normal and Industrial Institute for Colored Persons. Louisiana State Uni- versity and Agricult- ural and Mechanical College.....	Frankfort.....	J. H. Jackson, A. M.	.....	Normal, agr., carpentry, cooking, music, dressmaking, printing, blacksmithing, wheelwrighting (3 yrs.), business (1 yr.). Law (2 yrs., LL. B.), agr. (2 yrs.), agr. (10 weeks), stock, corn, and cotton judging (10 days).
		Baton Rouge.....	T. D. Boyd, M. A., LL. D.	.....	

\* Including also institutions receiving apportionments from the appropriation of 1890.

TABLE 1.—*Institutions established under the land-grant act of July 2, 1862, and their courses of study*—Continued.

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate).	
				Four-year courses and degrees.	Shorter courses.
Maine.....	Southern University and Agricultural and Mechanical College. The University of Maine.	New Orleans Orono.....	H. A. Hill..... G. E. Feltows, Ph. D., L. H. D., LL. D.	Class., sci., agr., mech., normal, printing, music. Class. (B. A.) sci., agr., hort., chem., civil engin., mech. engin., elect. engin., chem. engin., forestry, phar. (B. S.).	Agr., dairying, bookkeeping (2 yrs.), mech., tinamithing (3 yrs.), typewriting. Law (3 yrs., LL. B.), agr. (2 yrs.), phar. (Ph. C.) (2 yrs.), agr., hort., and dairying (8 weeks), poultry management and hort. (3 weeks), summer school for teachers (5 weeks), reading and correspondence courses in agr. Agr. and hort. (2 yrs.), prep. (1 yr.), agr. (10 weeks), dairying.
Maryland.....	Maryland Agricultural College. Princess Anne Academy for Colored Persons.	College Park..... Princess Anne.....	R. W. Silvester, M. S., LL. D. Frank Trigg, A. M.....	Agr., hort., chem., gen. sci., mech. engin., civil engin. (B. S.). Academic, normal.....	
Massachusetts.....	Massachusetts Agricultural College. Institute of Technology.	Amherst..... Boston.....	K. L. Butterfield, A. M.....	Agr. (B. S.)..... Civil engin., mech. engin., mining engin. and metal, archt., chem., elect. engin., biol., phys., electro-chem., chem. engin., sanitary engin., geol. and geodesy, naval archt. electiv. in general sci. (B. S.). Agr. engin., forestry, women's (B. S., each 4 and 5 yrs.).	Dairy farm., hort. (winter, 10 weeks), bee culture (2 weeks), summer school of agr.
Michigan.....	Michigan State Agricultural College.	East Lansing.....	J. L. Snyder, A. M., Ph. D.	General (B. A.), civil engin. (C. E.), mech. engin. (M. E.), elect. engin. (E. E.), mining, metal (E. M., Met. E.), chem. (A. C. or C. T.), agr. (B. S. Agr.), forestry (B. S. For.), home econ. (B. S.).	Cheese making (4 weeks), creamery management (6 weeks), live stock and general farming, fruit culture (8 weeks). Agr. (3 yrs.), home econ. (3 yrs.), agr. (8 weeks), dairying (4 weeks).
Minnesota.....	The University of Minnesota.	Minneapolis.....	Cyrus Northrop, LL. D.	Agr., hort., dairying, vet. sci., chem., mech. engin., phys. and elect. engin., civil and rural engin., geol. and mining, textile, indus. pedagogy (B. S.). Scientific (B. S.).....	
Mississippi.....	Mississippi Agricultural and Mechanical College.	Agricultural College.	J. C. Hardy, A. M., LL. D.		Agr., mech. arts, elect. engin., textile (2 yrs.), prep. (1 yr.), agr. (10 weeks), summer normal school for teachers (5 weeks). Business, carp., agr., shoemak., blackam., paint., dom. sci., millinery, etc. (3 yrs.), prep. (2 yrs.), primary (3 yrs.). Plant production, animal husb., dairying (8 weeks), summer school for teachers (8 weeks).
Missouri.....	Alcorn Agricultural and Mechanical College. University of Missouri.	Alcorn..... Columbia.....	L. J. Rowan, B. S..... A. R. Hill.....	Agr. (B. S.), civil engin. (B. S., C. E.), mech. engin., min. engin. (B. S., M. E.), elect. engin. (B. S., E. E.), san. engin., chem. engin., hydraulic engin., metal. (B. S.). Collegiate (B. A.), normal.....	College prep., normal (2 yrs.), normal prep., carpentry, blacksmithing, mach. work, sewing, cooking, laundering (3 yrs.), summer school (7 weeks).
	Lincoln Institute.....	Jefferson City ..	B. F. Allen, A. M., LL. D.		

Montana.....	Montana Agricultural College.	Bozeman.....	J. M. Hamilton, M. S.	General sci., domestic sci. (B. S.), agron., animal husb., dairying, hort. and forestry (B. S. A.), mech. engin. (B. M. E.), elect. engin. (B. E. E.), civil engin. (B. C. E.), art, music. Clas. lit. (B. A.), general sci., agr. home econ., civil engin., elect. engin., steam engin., municipal engin., mech. engin., grad. tech. for (B. S.), med. (M. D.). Liberal arts (B. A.), mining and metal. engin., domestic sci. (B. S.). Agr., mech. engin., elect. engin., chem. engin., general (B. S.).	Aggr. (3 yrs.), pract. mech. (2 yrs.), pharm. (2 yrs.), prep. (3 yrs.), domestic sci., water measuring (1 yr. each), creamery (4 weeks), agr. (10 days). El. agr. (3 yrs.), law (LL. B., 3 yrs.), mech. arts (2 yrs.), dairying, agr. (9 weeks), summer session (6 weeks), judging (1 week), art, music. Prep. (3 yrs.), agr., dairying, bot., ent. bact., domestic sci., assaying (3 months). Agr. (2 yrs.), agr. (winter, 10 weeks), dairying (10 weeks). Clay working and ceramics (2 yrs.), general agr., dairy farming, fruit growing, and market gardening (12 weeks each).
Nebraska.....	The University of Nebraska.	Lincoln.....	B. E. Andrews, LL. D.		
Nevada.....	University of Nevada.....	Reno.....	J. E. Stubbs, M. A., D. D., LL. D.		
New Hampshire.....	New Hampshire College of Agriculture and the Mechanic Arts.	Durham.....	W. D. Gibbs, M. S.....		
New Jersey.....	Rutgers Scientific School, The New Jersey State College for the Benefit of Agriculture and the Mechanic Arts.	New Brunswick	W. H. S. Demarest, D. D.		
New Mexico.....	New Mexico College of Agriculture and Mechanic Arts.	Agricultural College.	Luther Foster, M. S. A.	Aggr., mech. engin., civil engin., elect. engin., domestic sci., general or sci. (B. S.).	Aggr. and hort. (2 yrs.), pract. mech. (2 yrs.), prep. (2 yrs.), Engl. and Span. sten. (1 yr. each), commerce (2 yrs.), agr. and household econ. (2 yrs. of 4 winter months each). Law (LL. B., 3 yrs.), special lect. courses in general agr. and nature study (1 or 2 yrs.), poultry husb. (1 yr.), agr., dairying, poultry husb., hort., home econ. (winter, 11 weeks), reading courses for farmers and farmers' wives, summer school for teachers, nature study correspondence, course for teachers. Mech. arts, textile indus., applied electricity (2 yrs.), normal courses in agr. and nature study (1 and 2 years), agr. (1 yr.), agr. and dairying, textile indus. (10 weeks). Dairying (6 weeks).
New York.....	Cornell University.....	Ithaca.....	J. G. Schurman, A. M., D. Sc., LL. D.	Arts (A. B.), civil engin. (C. E.), mech. engin. (M. E.), elect. engin. (E. E.), archt. (B. Arch.), agr. (B. S. A.), med. (M. D.), vet. sci. (D. V. M.).	
North Carolina.....	The North Carolina College of Agriculture and Mechanic Arts.	West Raleigh...	G. T. Winston, A. M., LL. D.	Aggr. (B. Agr.), mech. engin., civil engin., elect. engin., mining engin., textile sci. and art (B. E.), indus. chem. (B. S.).	
North Dakota.....	The Agricultural and Mechanical College for the Colored Race, North Dakota Agricultural College.	Greensboro.....	J. B. Dudley, A. M., LL. D.	Aggr. (B. Agr.), mech. (B. S.), prep.....	
		Agricultural College.	J. H. Worst, LL. D...	Aggr., gen. sci., mech. engin., civil engin., pharm. chem. (B. S.).	Farm husb. (3 yrs.), steam engin., dairying, pharm., domestic econ. (2 yrs.), nature study and el. agr. for teachers (3 yrs.), prep. (2 yrs.), agr., steam engin., domestic econ. (winter, 12 weeks each), traction engin. (3 weeks), stock and grain judging (10 days), corresp. course in el. agr.



TABLE 1.—*Institutions established under the land-grant act of July 2, 1862, and their courses of study—Continued.*

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study and degrees.	
				Four-year courses and degrees.	Shorter courses.
Ohio.....	Ohio State University.	Columbus.....	W. O. Thompson, A. M., D. D., LL. D.	Agr. (B. S. Agr.), hort. and for. dom. sci., chem., indus. arts manual training phar. (B. S.) arts (B. A.) archi. civil engin. (C. E.) clay working and ceramics mining engin. (E. M.) elect. engin. (M. E. in E. E.) mech. engin. (M. E.) Agr., general sci., mech. engin., civil engin., elect. engin., sci. and lit. (S. B., B. S.).	Agr. and hort., ceramics, domestic sci., indus. arts, mining phar. (2 yrs.), dairying (10 weeks) agr. (10 weeks) vet. med. (3 yrs., D. V. M.), law (LL. B., 3 yrs.).
Oklahoma.....	Oklahoma Agricultural and Mechanical College.	Stillwater.....	J. H. Connell.....	Clas. (B. A.), sci. (B. S.), normal (B. S. D.), agr. (B. S. Agr.), elect. engin., mech. engin., civil archi. (B. M. E.).	Agr. and dom. sci. (2 yrs.), business, agr. (1 yr.), agr. and dairy (winter 10 weeks, spring 10 weeks) and seed selection (1 week), corresp. agr. for teachers (2 yrs.). Normal elementary (4 yrs.), college prep. (3 yrs.).
Oregon.....	Agricultural and Normal University.	Langston.....	I. E. Page, M. A.....	Agron., mech. engin., elect. engin., civil engin., mining engin., household sci., phar., lit., commerce, hort., forestry, animal husb., poultry husb. (B. S.).	Mining phar. (2 yrs.), agr., dairying (2 to 8 weeks), elementary agr. summer school for teachers (5 days).
Pennsylvania.....	Oregon State Agricultural College.	Corvallis.....	W. J. Kerr, D. Sc.....	Clas. (B. A.), mod. lang. and lit., general sci. (B. A.), lat. sci., philos., agr., forestry, home econ., biol., chem., civil engin., elect. engin., electrochem. engin., indus. chem., math., mech. engin., mines and metal., phys., sanitary engin. (B. S.).	Agr., mech., mining (2 yrs.), prep. (1 yr.), agr., hort., poultry husb., mining, dairying, and creamery (12 weeks), summer school (2 weeks) 31 corresp. courses in agr.
Pennsylvania.....	The Pennsylvania State College.	State College.....	J. A. Beaver, LL. D.....	Agr., mech. engin., highway engin., chem. engin., elect. engin., applied sci., and home econ. (B. S.).	Agr. (2 yrs.), engin. (2 yrs.), subfreshman (2 yrs.), poultry school (2 courses, 12 weeks each), textile indus. (2 yrs.), prep. (1 yr.).
Rhode Island.....	Rhode Island College of Agriculture and Mechanic Arts.	Kingston.....	Howard Edwards, M. A., LL. D.	Agr., agr. and chem., agr. and animal husb., mech. and elect. engin., civil engin., chem. and geol., textile indus. (B. S.).	Model school, indus., music, art.
South Carolina.....	Clemson Agricultural College of South Carolina.	Clemson College	P. H. Mell, Ph. D., LL. D.	Regular (B. A.), mech. (B. S.), agr. (B. Agr.), normal (L. I.), prep. and normal (5 yrs.).	
South Dakota.....	The Colored Normal, Industrial, Agricultural and Mechanical College of South Dakota.	Orangeburg.....	T. E. Miller, LL. D.....	Agr., domestic sci., general sci., mech. engin., elect. engin., civil engin. (B. S.).	Prep. (3 yrs.), phar. (2 yrs., Ph. G.), agr. (6 weeks), hort., domestic sci., butter making, cheese making, steam engin. (12 weeks), sten. and typewriting, commercial sci., steam engin. (1 yr.), phar. Dental surgery (D. D. S.), agr. (1 yr.), chem. (Ph. C., 2 yrs.), law (LL. B.), prep. med. (2 yrs.), agr., animal husb., dairy husb., poultry husb., bee keeping, home econ., hort. (2 weeks each), summer school for teachers (6 weeks).
South Dakota.....	South Dakota State College of Agriculture and Mechanic Arts.	Brookings.....	R. L. Slagle, A. M., Ph. D.	Lit. (B. A.), agr., home econ., sci., civil engin., mech. engin., elect. engin., mining engin., chem. engin., phar. chem. (B. S.), med. (M. D.).	
Tennessee.....	University of Tennessee	Knoxville.....	Brown Ayres, Ph. D., LL. D., D. C. L.		

Texas.....	Agricultural and Mechanical College of Texas. Prairie View State Normal and Industrial College. Agricultural College of Utah.	College Station. Prairie View..... Logan..... Burlington..... Blacksburg..... Hampton..... Pullman..... Morgantown..... Institute..... Madison..... Laramie.....	H. H. Harrington, LL. D. E. L. Blackshear..... J. A. Widtsoe, A. M., Ph. D. M. H. Buckham, D. D., LL. D. P. B. Barringer, M. D., LL. D. H. B. Frissell, D. D., LL. D. F. A. Bryan, M. A., LL. D. D. B. Purinton, Ph. D., LL. D. J. McHenry Jones, A. M. C. R. Van Hise, Ph. D. F. M. Thedel, Ph. D....	<p>Agr., hort., animal husb., textile engin., elect. engin., mech. engin., civil engin., archt. engin. (B. S.). Clas. and sci. (6 yrs., B. A.), normal industrial optional along agr. or mech. lines.</p> <p>Agron., hort. and ent., animal husb. and dairying, irrig. and drainage, vet. sci., domestic sci., commerce, general sci. (B. S.), manual training in mech. arts.</p> <p>Clas. (B. A.), lit. sci. (Ph. B.), civil and sanitary engin., elect. engin., mech. engin., chem., agr., commerce and econ. (B. S.), med. (M. D.), dairying.</p> <p>Agr., hort., applied chem., general sci., civil engin., mech. engin., elect. engin., metal. and metallurgy, applied geol., prep. med. and vet. sci. (B. S.).</p> <p>Academic.....</p> <p>Math. and civil engin., domestic econ., pharm., chem., bot. and zool., agron., animal husb., dairying, hort., vet. sci., econ. sci. and hist., elect. engin., mech. engin., mining engin. (B. S., B. A.), geol., Engl. lang. and lit., modern lang., Latin, education, archt. (B. A.).</p> <p>General cultura (B. A., B. S.), mech. and elect. engin. (B. S., M. E. and B. S., E. E.), civil engin. (B. S., C. E.), mining engin. (B. S., E. M.), agr. (B. S. Agr.), law (LL. B.), music.</p> <p>Academic, normal, agr.....</p> <p>Sci., home econ., commerce (B. A.) normal (B. Ph.) agr. (B. S. Agr.) civil engin., sanitary engin., mech. engin., elect. engin., general engin., applied electrochem., chem. (B. S.), education (B. A.), normal (B. Ph.), polit. sci., hist., general sci., agr., mech. engin., mining engin., irrig. engin. (B. S.), music, commerce.</p>	<p>Agr. (2 yrs.), agr. (6 weeks).</p> <p>Mech. arts, agr. and hort., and dairying.</p> <p>Agr., domestic sci., commerce (3 yrs.), manual training course in domestic sci. (3 yrs.), prep. (2 yrs.), general sci. (2 yrs.), dairying (1 yr.), agr. (4 weeks), domestic sci. and arts, mech. arts, commerce (12 weeks), dairying (2 weeks), summer school for teachers (5 weeks). Agr. (1 or 2 yrs.).</p> <p>Agr., mech. (2 yrs.), summer school (6 weeks).</p> <p>Trade (3 yrs.). Postgraduate: Agr., trades (3 yrs.), normal (2 yrs.), business (1 yr.). Phar. (2 yrs., Ph. G.), agr., vet. sci. (D. V. S.), prep. (3 yrs.), forestry (3 yrs.), business (1 and 2 yrs.), artisans (1 yr.), agr. (20 weeks), assaying (12 weeks), dairying (8 weeks), hort. (4 weeks), music (3 yrs.), summer science school for teachers (6 weeks).</p> <p>Agr. mech. and elect., law, commercial (2 yrs.), agr. prep. (1 yr.), agr., hort., vet. sci., stock breeding and feeding, dairying, poultry culture (12 weeks), nature study summer school (6 weeks), Sewing (2 yrs.), dressmaking (2 yrs.), commercial (2 yrs.), mech. printing (3 yrs.). Law (LL. B.), phar. (Ph. G. 2 yrs.), music, agr. (2 winter courses, 14 weeks each), dairy school (12 weeks), creamery (summer) farmers' course (2 weeks), summer school (6 weeks). Prep. (3 yrs.) prep. med., prep. law (2 yrs.), agr. (1 to 2 yrs.), agr. (12 weeks), school mines (6 weeks), animal husb. (winter), domestic sci., irrig., live-stock management and judgment (2 weeks), corresp. courses.</p>
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a Acting president.

TABLE 2.—General statistics

	State or Territory.	Date of es- tablish- ment of in- stitu- tion.	Date of es- tablish- ment of agri- cul- tural course.	Faculty.			Other depart- ments.	Experi- ment station officers.
				College of agriculture and mechanic arts.				
				Pre- para- tory classes. (a)	Colle- gate and special classes.	Total.		
1	Alabama (Auburn).....	1872	1872	4	42	46		1
2	Alabama (Normal).....	1875	1882	4	8	12	14	
3	Arizona.....	1891	1891	10	15	25		10
4	Arkansas (Fayetteville).....	1872	1872	11	49	60	56	14
5	Arkansas (Pine Bluff).....	1875		9	9	b 9		
6	California.....	1868	1868		62	62	199	42
7	Colorado.....	1877	1878	15	37	b 39		24
8	Connecticut.....	1881	1881		19	19		11
9	Delaware (Newark).....	1870	1870		20	20	1	9
10	Delaware (Dover).....	1892	1892	6	6	b 8		
11	Florida (Gainesville).....	1884	1884	2	15	b 16		14
12	Florida (Tallahassee).....	1887	1890	21		21		
13	Georgia (Athens).....	1872	1872		25	25		
14	Georgia (Savannah).....	1890	1890	11	4	15		
15	Idaho.....	1892	1892	5	22	27	9	10
16	Illinois.....	1867	1868		163	163	319	44
17	Indiana.....	1874	1874		125	125		33
18	Iowa.....	1869	1869		137	137		27
19	Kansas.....	1863	1874	6	70	76	17	27
20	Kentucky (Lexington).....	1865	1880	5	39	44		20
21	Kentucky (Frankfort).....	1887	1892	3	10	13		
22	Louisiana (Baton Rouge).....	1877	1887	7	35	b 36	4	27
23	Louisiana (New Orleans).....	1880	1890	9	8	17		
24	Maine.....	1865	1868	6	52	b 53	11	17
25	Maryland (College Park).....	1859	1859		22	22		18
26	Maryland (Princess Anne).....			9		9		
27	Massachusetts (Amherst).....	1867	1867		32	32		30
28	Massachusetts (Boston).....	1865			241	241		
29	Michigan.....	1855	1855		74	74		19
30	Minnesota.....	1869	1869	42	45	87	133	24
31	Mississippi (Agricultural Col- lege).....	1880	1880	7	37	44		17
32	Mississippi (Alcorn).....	1871	1878	6	5	11	9	
33	Missouri (Columbia).....	1870	1870		109	109	98	37
34	Missouri (Jefferson City).....	1866	1866	2		2	18	
35	Montana.....	1893	1893	14	30	b 32		12
36	Nebraska.....	1869	1869	26	46	b 67	260	26
37	Nevada.....	1873	1888	8	34	34		12
38	New Hampshire.....	1866	1886		26	26		14
39	New Jersey.....	1864	1865	11	28	39	5	12
40	New Mexico.....	1889	1890	3	32	35		18
41	New York.....	1865	1865			c 517		24
42	North Carolina (West Raleigh).....	1889	1889		42	42		13
43	North Carolina (Greensboro).....	1891	1891		11	11		
44	North Dakota.....	1890	1890	26	25	b 34	15	22
45	Ohio.....	1870	1873		125	125	39	33
46	Oklahoma (Stillwater).....	1891	1892		31	31		13
47	Oklahoma (Langston).....	1897	1899	2	5	7	8	
48	Oregon.....	1868	1888		39	39		19
49	Pennsylvania.....	1855	1859	4	79	83		35
50	Rhode Island.....	1888	1890	9	25	b 25		14
51	South Carolina (Clemson Col- lege).....	1889	1893	2	41	43		21
52	South Carolina (Orangeburg).....	1896	1896	8	6	14	8	
53	South Dakota.....	1881	1884	3	34	37		15
54	Tennessee.....	1794	1869		62	62	38	22
55	Texas (College Station).....	1871	1871		45	45		19
56	Texas (Prairie View).....			8	7	15		
57	Utah.....	1888	1889	14	14	28	30	22
58	Vermont.....	1865	1885		41	41	33	17
59	Virginia (Blacksburg).....	1872	1872		57	57		24
60	Virginia (Hampton).....	1868	1890	124		124		
61	Washington.....	1892	1892		68	68		17
62	West Virginia (Morgantown).....	1867	1867		25	25	41	14
63	West Virginia (Institute).....	1891	1892	5	14	19	3	
64	Wisconsin.....	1848	1866		73	73	254	44
65	Wyoming.....	1887	1891	15	15	b 21	5	12
Total.....				482	2,617	3,518	1,627	985

<sup>a</sup> Including schools of agriculture of high school grade under the control of the institution.<sup>b</sup> Total, counting none twice.<sup>c</sup> Including all departments of the university.

*of land-grant colleges, 1907.*

Graduates.			Library.		Number of acres allotted to State under act of 1862.	Number of acres of land grant of 1862 still unsold.	Num-ber of acres in farm and grounds.	Rate of interest on land-grant fund of 1862.	
In 1906-7.		Total number since organi-zation.	Number of volumes.	Number of pamphlets.					
Num-ber.	Average age.								
	Y. M.							Per cent.	
82	20	969	22,000	2,300	240,000		325	8	1
93	19	1,239	198	1,323			182		2
5	24	55	11,000	12,000			465		3
68	24	510	10,000	4,000	150,000		160	8	4
8	22	191	3,000				20		5
445	23 6	c 4,887	210,000	100,000	150,000	1,402	779	6	6
23		308	21,200	18,000	90,000	40,000	1,818	6	7
17	21 9	266	10,560	1,000	180,000		656	5	8
26	23 5	410	16,000	9,000	90,000		227	6	9
8		47	1,000	1,000			97		10
4	20	111	5,000		90,000		527	6	11
7	22	108							12
17	21	437	41,000	7,000	270,000		800	7	13
10	24	176	700	400			86		14
33	23	189	8,200	2,200	90,000	86,400	225		15
365	23 6	c 4,949	105,320	29,277	480,000	40	665	5	16
291	23 8	2,715	18,534	4,000	390,000		241	5	17
137			22,000		204,000		1,175	6, 7, 8	18
113	22 6	1,329	29,424	600	82,313		430	5, 5 1/2, 6, 7	19
70	21	608	6,550	15,801	330,000		298	6	20
21	22	169	1,250	1,724			310		21
43	22	459	25,500		210,000		664	4, 5	22
26	18 6	385	2,633	1,650			104		23
114	23 7	1,164	34,000	9,000	210,000		373	5	24
15	21 6		5,200	4,100	210,000		286	5, 6	25
16	20	62	200	800			116		26
23	23	713	28,000		360,000		404	5	27
208	23	3,633	74,695	20,982			18		28
96		1,271	28,117	5,324	235,673	51,387	684	7	29
592		c 6,549	110,000	25,000	94,000	40	325	3, 4, 5	30
37	21 6	462	11,832	11,919	207,920		2,000	6	31
16	23	187	2,700				300		32
77		2,731	81,694	2,000	277,016	47,607	722	5	33
33	21	405	3,000	3,000			48		34
18	22 5	68	8,924	6,000	90,000	85,780	220		35
242	22	c 2,892	72,445		90,000		332	4 1/2, 6	36
36		331	27,222	22,000	90,000	3,000	73	4, 6	37
14	22 6	316	13,476	3,800	150,000		343	6	38
27	22 7	636	51,920	5,000	210,000		142	5	39
6	21 7	70	13,356	9,220			458		40
670		c 9,369	339,701	51,000	989,920		498	5	41
52	22 7	356	5,024	1,680	270,000		685	6	42
11	23	67	1,441	15,500			128		43
5	25 2	56	9,600	1,050	130,000	67,000	640		44
233	23	2,390	72,532	1,000	630,000		439	6	45
18		161	11,751				1,000		46
64		657	1,100	200			160		47
131	23 3	1,036	5,000		90,000	4,200	210	6	48
9	22	125	25,446		780,000		400	6	49
69	21 11	465	15,102	5,000	120,000		178	3	50
			15,062	3,880	180,000		1,136	6	51
36	20	419	900	700			130		52
29	23	333	10,200	10,850	160,000	156,202	560		53
35	22 6		26,550	17,150	300,000		272	6	54
48	22	628	6,212	7,570	180,000		2,416	6, 7	55
79	22	519	900	300			1,400		56
8	22 6	142	16,830	14,321	200,000	47,218	116		57
74	23 3	3,948	74,798	37,936	150,000		146	6	58
67	20 8	728	7,500	3,500	300,000		410	6	59
63		1,442	22,186				758		60
12	23	256	13,000	3,500	90,000	89,000	410		61
93	23	1,112	28,834		150,000		148	6	62
22	18	165	2,110	820			70		63
475	23	c 6,192	122,000	35,000	240,000	312	500	4	64
13	21	151	22,010	11,000	90,000		416		65
5,798	22 2	72,724	1,993,639	561,377	10,320,842	769,588	30,324		

TABLE 3.—Students, by classes and

## PART 1.—WHITE STUDENTS.

	State or Territory.	By classes.						By courses.	
		Preparatory. <sup>a</sup>	Collegiate.	Short or special. <sup>b</sup>	Post-graduate.	Other departments.	Total.	Four-year.	
								Agriculture.	Horticulture.
1	Alabama.....	57	528		15		600	12	21
2	Arizona.....	142	70		3		215		
3	Arkansas.....	536	570	41	5	464	1,616	41	18
4	California.....		926	8	40	1,795	c 2,761	127	
5	Colorado.....	171	204	195	2	32	604	35	13
6	Connecticut.....		124	116			e 233	65	12
7	Delaware.....		126		3		129	1	
8	Florida.....	19	21		1	62	103	1	1
9	Georgia.....		229	64	1		294	34	
10	Idaho.....	132	109	10		124	375	3	
11	Illinois.....		1,739		93	2,484	4,316	d 368	
12	Indiana.....		1,554	215	51		1,820	d 87	
13	Iowa.....	331	1,249	765	15	21	2,381	277	e 29
14	Kansas.....	655	1,010	336	24		e 1,937	197	
15	Kentucky.....	115	455	191	11	129	901	22	
16	Louisiana.....	113	358	48	7	23	549	22	
17	Maine.....	10	521	77	15	90	e 687	25	1
18	Maryland.....	23	156	32	4		215	14	16
19	Massachusetts.....		223	48	8		279	220	
20	Massachusetts (Boston).....		1,365	229	32		e 1,397		
21	Michigan.....	140	658	203	5		e 1,001	162	
22	Minnesota.....	747	530			2,849	4,126	f 72	
23	Mississippi.....	257	672	431	14		1,374	195	
24	Missouri.....		733	77	49	1,433	2,292	121	
25	Montana.....	104	132	132	4		372	10	
26	Nebraska.....	235	641	210	48	2,044	e 3,130	26	
27	Nevada.....	104	220			23	347	1	
28	New Hampshire.....		165	42	1		208	13	
29	New Jersey.....	140	174	38	4	57	413	3	
30	New Mexico.....	140	89	32			261	9	
31	New York.....		1,359	244		2,806	4,409	278	
32	North Carolina.....		338	91	7		436	60	
33	North Dakota.....	128	59	236	4	397	824	26	
34	Ohio.....		970	501	7	969	e 2,277	112	12
35	Oklahoma.....	93	494	446			1,033	ø 27	
36	Oregon.....	132	631	56	14		833	80	
37	Pennsylvania.....	62	775	57	4	h 3,100	3,998	36	2
38	Rhode Island.....	45	73	21	4		143	4	
39	South Carolina.....	100	549	9			658	219	
40	South Dakota.....	202	183	163	4		552	12	1
41	Tennessee.....		374	158	5	225	762	20	14
42	Texas.....		506	9			515	d 98	
43	Utah.....	189	75	98	1	354	717	22	
44	Vermont.....		372		2	161	535	37	
45	Virginia.....		500		17		577	45	8
46	Washington.....	253	473	360	14		1,100	59	26
47	West Virginia.....		95		3	1,159	1,257	5	
48	Wisconsin.....		929	585	20	2,125	3,659	142	
49	Wyoming.....	62	16		5	181	264	5	
	Total.....	5,437	24,382	6,565	575	23,107	59,485	3,450	174

<sup>a</sup> Including schools of agriculture of high school grade under the control of the institution.<sup>b</sup> Including summer school.<sup>c</sup> Total, counting none twice.<sup>d</sup> Including horticulture.<sup>e</sup> Including forestry.<sup>f</sup> Including horticulture, forestry, veterinary science and household economy.<sup>g</sup> Including horticulture and forestry.<sup>h</sup> Correspondence course.

*courses, at land-grant colleges in 1907.*

## PART 1.—WHITE STUDENTS.

By courses.														
Four-year.				Shorter.										
For- estry.	Veter- inary sci- ence.	House- hold econ- omy.	Engi- neer- ing.	Mechan- ic arts.	Agric- ulture.	Hortic- ulture.	For- estry.	Dairy- ing.	Vet- erinary sci- ence.	House- hold econ- omy.	Teachers' courses in agriculture.		Mili- tary tac- tics.	
											Two- year.	Sum- mer school.		
	35		271										559	1
	6		34										100	2
			171	32	25	25		25	16				602	3
			826		8								848	4
		74	82		140		29			22			289	5
		9	4	6	12	2		8		13		84	95	6
			94										120	7
			19		2								95	8
			75			19	6	19	6			45	248	9
		3	100		6	2		2		77		10	175	10
			82										1,175	11
			1,142										961	12
			1,753	33	120	37	37	17	54	6			373	13
	82	20	782		765	1		79		32			350	14
	50	239	367		179			23		134			286	15
		28	300	21	10								332	16
			137		2							300	164	17
33			320		28								150	18
			85		36	10							167	19
								38					286	20
34		161	897		119	18		61					446	21
			308										485	22
			596										23	23
			276		52	14		4				414	353	24
			618										25	25
		27	60	39	23					25			568	26
33		31	430	20	194								118	27
			141	30						70			170	28
			130		31			13					171	29
			80		38								121	30
		8	28	6	1								400	31
			1,629		244				86				345	32
			265	32	31			12					275	33
			33	179	165					21			833	34
		42	682	13	51			20	125	15	24		35	35
			113	20	480						59		530	36
5		81	233		56								81	37
9			607		32		1	33					655	38
			54		21								217	39
			311		1			1					170	40
		12	62	71	59			9		26			515	41
		36	98		77	10				22		72	43	42
			371	9	37								209	43
		11	23	123	88			15		87			163	44
			135										538	45
	9		405	7	6			4					382	46
	12	75	252	27	26	18	6	12	18				225	47
	6		93		20								625	48
		82	827		327			164					78	49
			11	1	1									49
114	200	1,047	16,330	669	3,532	156	79	559	305	550	83	925	16,048	

TABLE 3.—*Students by classes and courses*

## PART 2.—NEGRO STUDENTS.

State or Territory.	By classes.					By courses.		
	Preparatory.	Collegiate.	Short or special.	Other departments.	Total.	Agriculture.	Carpentry.	Machine-shop work.
1 Alabama (Normal).....	140	10	49	144	343	144	17	12
2 Arkansas (Pine Bluff).....	200	80			280		91	18
3 Delaware (Dover).....	61	56			117	31	35	10
4 Florida (Tallahassee).....	294				294	23	14	
5 Georgia (Savannah).....	335	11			346	3	23	
6 Kentucky (Frankfort).....	122	60			182	17	29	
7 Louisiana (New Orleans).....	382	5			387	51	56	56
8 Maryland (Princess Anne).....	134				134	98	12	
9 Mississippi (Alcorn).....	416	82			498	80	75	
10 Missouri (Jefferson City).....	151	4	95	757	1,007	51	57	14
11 North Carolina (Greensboro).....		178			178	178	47	11
12 Oklahoma (Langston).....	240	77	36		353	47	38	12
13 South Carolina (Orangeburg).....	554	46			600	20	20	42
14 Texas (Prairie View).....	263	207			470	100	24	
15 Virginia (Hampton).....	1,295				1,295	808	66	15
16 West Virginia (Institute).....	89			135	224	8	12	
Total.....	4,676	816	180	1,036	6,708	1,659	616	190

at land-grant colleges in 1907—Continued.

## PART 2.—NEGRO STUDENTS.

By courses.														
Blacksmith- ing.	Shoemaking.	Wheelwright- ing.	Bricklaying.	Painting.	Printing.	Harness making.	Tailoring.	Plastering.	Sewing.	Cooking.	Laundrying.	Nursing.	Millinery.	Military tactics.
17	11	17	22	17	215		17	4	68	12	18	18	13	126
38				3					130					150
4					2				30	20	16			60
10		6	10	7	7		16		120	105		27	16	107
26	18	14	33	21		1	39	33	54					125
					29				75	31				76
					20									
					11				62	65	9			
5		4							50	26	90	16	50	
59	25	15	4	15		25		3	175	130			23	
25														
20			51					12						178
25									149	59			8	
42									341					
20	20	5	75	6		20		75	165	165	125	12	40	246
32		2							690	296	104		2	
15	6	8	50	10	8	3	33	50	106	71			19	98
		8	10	7	8			10						
338	80	79	255	86	300	49	105	187	2,215	980	362	73	171	1,646



TABLE 4.—Value of permanent funds and

	State or Territory.	Land-grant fund of 1862.	Other land-grant funds.	Other permanent funds.	Land grant of 1862 still unsold.	Farm and grounds owned by the institution.
1	Alabama (Auburn).....	\$253,500.00				\$9,000.00
2	Alabama (Normal).....					10,000.00
3	Arizona.....					29,140.00
4	Arkansas (Fayetteville)...	130,000.00				15,000.00
5	Arkansas (Pine Bluff).....					50,000.00
6	California.....	732,233.14	\$154,712.27	\$2,946,722.31	\$11,818.27	131,943.18
7	Colorado.....	130,855.62			125,000.00	225,000.00
8	Connecticut.....	135,000.00		61,000.00		25,000.00
9	Delaware (Newark).....	83,000.00				45,000.00
10	Delaware (Dover).....					8,000.00
11	Florida (Gainesville).....	153,800.00				50,000.00
12	Florida (Tallahassee).....					10,000.00
13	Georgia (Athens).....	242,202.17				100,000.00
14	Georgia (Savannah).....					3,144.00
15	Idaho.....	7,224.05	302,903.98		804,000.00	32,500.00
16	Illinois.....	639,041.53			400.00	175,000.00
17	Indiana.....	340,000.00				110,000.00
18	Iowa.....	683,708.52				116,108.00
19	Kansas.....	492,381.36				52,567.00
20	Kentucky (Lexington).....	165,000.00				465,393.00
21	Kentucky (Frankfort).....					25,100.00
22	Louisiana (Baton Rouge).....	182,313.00	136,000.00			151,040.00
23	Louisiana (New Orleans).....					40,000.00
24	Maine.....	118,300.00		100,000.00		50,000.00
25	Maryland (College Park).....	118,000.00				30,000.00
26	Maryland (Princess Anne).....					3,480.00
27	Massachusetts (Amherst).....	219,000.00		142,000.00		44,350.00
28	Massachusetts (Boston).....			1,857,448.06		2,573,647.76
29	Michigan.....	978,187.49			77,080.50	48,107.50
30	Minnesota.....	570,749.59	836,048.56		240.00	600,000.00
31	Mississippi (Agricultural College).....	98,575.00	141,212.55	250.00		60,040.00
32	Mississippi (Alcorn).....	113,575.00	96,296.00			6,000.00
33	Missouri (Columbia).....	349,881.19	220,000.00	676,958.23	60,000.00	265,206.00
34	Missouri (Jefferson City).....					20,000.00
35	Montana.....	d 121,385.00			225,000.00	31,000.00
36	Nebraska.....	474,168.13	175,707.82		68,635.00	250,000.00
37	Nevada.....	101,710.00	43,415.34		3,750.00	125,000.00
38	New Hampshire.....	80,000.00		70,000.00		20,500.00
39	New Jersey.....	116,000.00		648,416.94		152,000.00
40	New Mexico.....		19,231.47			46,500.00
41	New York.....	688,576.12		7,806,966.91		429,077.98
42	North Carolina (West Raleigh).....	125,000.00				60,000.00
43	North Carolina (Greensboro).....					27,000.00
44	North Dakota.....	766,376.65			804,000.00	32,000.00
45	Ohio.....	524,176.58	82,715.13	200,838.84		1,540,000.00
46	Oklahoma (Stillwater).....		500,000.00	750,000.00		40,000.00
47	Oklahoma (Langston).....					8,000.00
48	Oregon.....	193,778.00			5,000.00	40,000.00
49	Pennsylvania.....	427,290.50		89,709.00		40,000.00
50	Rhode Island.....	50,000.00				14,855.00
51	South Carolina (Clemson College).....	95,900.00		58,539.39		42,470.00
52	South Carolina (Orangeburg).....	95,900.00				40,000.00
53	South Dakota.....	62,287.59			1,562,020.00	60,000.00
54	Tennessee.....	400,000.00	5,000.00	22,000.00		285,475.00
55	Texas (College Station).....	209,000.00				50,000.00
56	Texas (Prairie View).....					14,000.00
57	Utah.....	183,442.77			70,827.00	23,200.00
58	Vermont.....	135,500.00		563,691.00		37,000.00
59	Virginia (Blacksburg).....	344,312.00				31,000.00
60	Virginia (Hampton).....	172,156.00		1,523,226.22		57,000.00
61	Washington.....	2,000.00	1,025,000.00		890,000.00	32,000.00
62	West Virginia (Morgantown).....	114,169.00		1,600.00		400,000.00
63	West Virginia (Institute).....					10,000.00
64	Wisconsin.....	303,359.61	288,263.95	62,500.00	340.00	1,500,000.00
65	Wyoming.....	21,450.57	7,507.53		90,000.00	40,000.00
	Total.....	12,744,466.18	4,034,014.60	17,581,866.90	4,858,110.77	11,055,844.42

a Including ground.

b Including apparatus.

c Including apparatus and machinery.

d Including other land-grant funds.

e Including machinery and other equipment.

*equipment of land-grant colleges, 1907.*

Buildings.	Apparatus.	Machinery.	Libraries.	Live stock.	Miscellaneous equipment.	Total.	
\$155,500.00	\$23,794.00	\$25,488.00	\$40,522.00	\$2,500.00		\$510,304.00	1
65,445.00	6,960.00	4,091.00	300.00	600.00	\$3,349.00	90,745.00	2
153,358.89	29,925.95	19,734.58	22,274.05	1,270.00		255,703.47	3
350,000.00	75,000.00	85,000.00	40,000.00	3,000.00	1,500.00	699,500.00	4
18,000.00	200.00	12,000.00	1,800.00		1,000.00	83,000.00	5
a 4,009,686.09						7,987,115.26	6
190,251.00	56,000.00	20,516.60	32,444.15	12,063.00	25,000.00	817,130.37	7
175,000.00	8,311.00	20,000.00	20,000.00	10,400.00	20,655.00	463,902.00	8
130,000.00	60,000.00	19,000.00	24,000.00	2,000.00	840.00	363,840.00	9
26,000.00	1,000.00	800.00	300.00	1,000.00	500.00	35,600.00	10
100,000.00	25,000.00	10,000.00	8,000.00	200.00	5,000.00	352,000.00	11
25,000.00	5,800.00	2,000.00		1,720.00	4,175.00	48,695.00	12
a 550,000.00	37,000.00		45,000.00	1,400.00	2,000.00	977,602.17	13
32,433.04	250.00	2,000.00	500.00	415.00	100.00	38,842.04	14
175,000.00	7,825.64	9,778.80	5,300.00	5,261.00	16,831.18	1,426,624.65	15
1,500,000.00	250,000.00	165,000.00	155,000.00	30,000.00	160,000.00	3,074,441.53	16
750,000.00		b 225,000.00	28,000.00	10,000.00	25,000.00	1,488,000.00	17
1,355,936.00		b 87,375.64	78,354.75	28,677.53	282,915.30	2,633,075.74	18
456,807.00	52,407.00	42,930.00	55,448.00	24,462.00	151,890.00	1,328,892.36	19
299,192.00	58,244.00	28,205.00	15,454.00	3,761.00	433,022.00	1,468,271.00	20
40,000.00	300.00	2,700.00	2,120.00	2,500.00	1,446.50	74,166.50	21
437,700.00	22,116.08	18,818.66	32,377.53	1,540.00	31,353.44	1,013,258.71	22
45,160.82	3,744.31	4,563.06	3,990.00	1,290.00	7,762.58	106,510.77	23
350,000.00	37,000.00	23,000.00	40,000.00	5,000.00	20,000.00	743,300.00	24
170,000.00	10,000.00	40,000.00	10,000.00	500.00		378,500.00	25
20,100.00	350.00	500.00	500.00	800.00	2,000.00	27,730.00	26
331,775.00	21,169.79	3,530.95	28,000.00	10,375.00	112,226.59	912,427.33	27
891,036.33			159,866.62		c 486,188.00	5,968,186.77	28
576,613.00	42,032.47	37,260.00	48,921.83	11,756.50		1,819,959.29	29
2,049,566.00	124,500.00	100,000.00	120,000.00			4,401,104.15	30
389,982.90	26,091.92	149,777.48	26,251.78	38,441.29	106,943.68	1,037,566.60	31
200,000.00	10,000.00		3,500.00	3,000.00		432,371.00	32
1,000,000.00	159,000.00	30,000.00	149,000.00	16,500.00	126,000.00	3,052,545.42	33
150,000.00				500.00		170,500.00	34
124,000.00	47,000.00	16,000.00	17,600.00	5,260.00	21,500.00	608,745.00	35
774,975.00	125,000.00	25,000.00	155,000.00	25,716.00	82,488.00	2,156,689.95	36
189,769.74	21,994.06	15,877.90	22,563.54	3,468.53	47,516.69	575,065.80	37
268,000.00	28,000.00	6,800.00	15,000.00	4,500.00	16,000.00	508,800.00	38
512,000.00	36,000.00		52,000.00		80,000.00	1,596,416.94	39
63,500.00	20,775.00	29,000.00	33,702.00	2,995.00	9,000.00	224,703.47	40
3,775,296.71			680,683.00		955,729.38	14,336,330.10	41
263,900.00	16,612.00	51,491.00	5,192.00	3,357.00	28,965.13	554,517.13	42
65,000.00		11,299.83	1,879.00	3,072.00	9,857.00	118,107.83	43
305,795.28	19,554.84	17,147.45	20,905.62	9,000.00	8,457.05	1,983,236.89	44
1,220,000.00	320,000.00	100,000.00	205,000.00	15,000.00		4,207,730.55	45
207,500.00	71,823.16	39,170.00	24,874.26	18,043.00	26,591.56	1,678,001.98	46
57,000.00	2,500.00	10,000.00	2,300.00	1,200.00	3,200.00	84,200.00	47
180,000.00	6,000.00	30,000.00				454,778.00	48
1,276,975.00	c 150,000.00		37,000.00	2,607.50		2,023,582.00	49
187,139.90	29,225.06	12,453.55	20,000.00	1,090.00	16,684.29	331,447.80	50
474,870.69	24,986.00	108,158.50	26,671.22	14,233.00		845,828.80	51
88,500.00	7,150.00	7,150.00	1,700.00	2,450.00	2,300.00	245,150.00	52
225,000.00	21,000.00	18,000.00	5,750.00	10,000.00	3,500.00	1,967,557.59	53
238,148.67	59,873.74	58,846.24	17,257.26	4,684.50	17,302.94	1,108,588.35	54
500,000.00	170,000.00	55,000.00	15,242.00	11,000.00	31,000.00	1,041,242.00	55
100,000.00	1,200.00	4,000.00	1,000.00	3,500.00	1,200.00	124,900.00	56
305,578.04	30,368.96	26,010.23	14,020.79	8,402.83	32,976.19	694,826.81	57
870,000.00	46,000.00	23,000.00	112,197.00	4,550.00	170,000.00	1,961,938.00	58
425,469.00			6,377.00		c 182,327.00	989,485.00	59
682,000.00			9,000.00	22,208.00	172,000.00	2,637,590.22	60
275,000.00	34,000.00	43,850.00	26,000.00	6,500.00	18,000.00	2,352,350.00	61
520,000.00	15,000.00	38,000.00	47,500.00	1,500.00	51,000.00	1,188,769.00	62
96,000.00	3,000.00	12,650.00	2,500.00	1,200.00	125,350.00	250,700.00	63
1,737,300.00	315,573.31	21,410.83	254,504.10	27,766.65	92,580.51	4,603,598.96	64
185,000.00	69,039.71	36,717.00	31,979.45	5,975.50	10,000.00	497,669.76	65
33,363,261.10	2,845,698.00	1,994,638.30	3,062,622.95	450,211.83	4,243,224.01	96,233,959.06	

TABLE 5.—Revenue of land-grant colleges

	State or Territory.	Federal aid.			State aid.	
		Interest on land grant of 1862.	Interest on other land grants.	Appropriation act of 1890.	Interest on endowment or regular appropriation.	Appropriation for current expenses.
1	Alabama (Auburn).....	\$20,280.00		\$13,725.00		\$32,000.00
2	Alabama (Normal).....			11,275.00		4,000.00
3	Arizona.....			25,000.00		32,000.00
4	Arkansas (Fayetteville).....	3,900.00		18,181.82		75,000.00
5	Arkansas (Pine Bluff).....			6,818.18		14,500.00
6	California.....	40,199.60	\$8,493.70	25,000.00	\$41,175.00	393,282.49
7	Colorado.....	18,354.31		25,000.00		69,755.00
8	Connecticut.....	6,750.00		25,000.00		20,000.00
9	Delaware (Newark).....	4,980.00		20,000.00		
10	Delaware (Dover).....			5,000.00		
11	Florida (Gainesville).....	7,710.00	2,500.00	12,500.00		8,450.00
12	Florida (Tallahassee).....			12,500.00		3,000.00
13	Georgia (Athens).....	16,954.14		16,666.67		
14	Georgia (Savannah).....			8,333.33		8,000.00
15	Idaho.....		27,000.00	25,000.00		14,250.00
16	Illinois.....	32,409.62		25,000.00		350,000.00
17	Indiana.....	17,000.00		25,000.00		155,637.39
18	Iowa.....	36,127.93		25,000.00		159,702.16
19	Kansas.....	29,811.62		25,000.00		100,000.00
20	Kentucky (Lexington).....	8,644.50		21,375.00		42,607.81
21	Kentucky (Frankfort).....	1,255.50		3,625.00		8,000.00
22	Louisiana (Baton Rouge).....	9,115.69	5,440.00	13,158.62		25,000.00
23	Louisiana (New Orleans).....			11,841.38		10,000.00
24	Maine.....	5,915.00		25,000.00		40,000.00
25	Maryland (College Park).....	5,797.16		20,000.00		15,000.00
26	Maryland (Princess Anne).....			5,000.00		
27	Massachusetts (Amherst).....	7,300.00		16,666.66	3,896.65	42,499.99
28	Massachusetts (Boston).....	5,306.68		8,333.34		25,000.00
29	Michigan.....	70,155.22		25,000.00		70,000.00
30	Minnesota.....	22,220.36		25,000.00	32,532.94	263,904.65
31	Mississippi (Agricultural College).....	5,914.50	8,472.75	12,339.20		65,936.46
32	Mississippi (Alcorn).....	6,814.50	5,777.77	12,660.80		8,000.00
33	Missouri (Columbia).....	17,494.10	12,320.00	23,437.50	33,097.86	251,072.75
34	Missouri (Jefferson City).....			1,562.50		27,200.00
35	Montana.....	7,000.00		25,000.00		25,000.00
36	Nebraska.....	29,241.00	14,620.00	25,000.00		202,500.00
37	Nevada.....	4,580.20	3,949.23	25,000.00		85,000.00
38	New Hampshire.....	4,800.00		25,000.00		13,000.00
39	New Jersey.....	5,800.00		25,000.00		18,600.00
40	New Mexico.....		655.51	25,000.00		12,652.46
41	New York.....	34,428.80		25,000.00		125,000.00
42	North Carolina (West Raleigh).....	7,500.00		16,750.00		25,000.00
43	North Carolina (Greensboro).....			8,250.00		7,500.00
44	North Dakota.....	44,422.25		25,000.00		33,678.96
45	Ohio.....	31,450.59	4,569.43	25,000.00		358,928.85
46	Oklahoma (Stillwater).....		20,703.44	22,500.00		17,632.98
47	Oklahoma (Langston).....			2,500.00		31,293.00
48	Oregon.....	11,299.76		25,000.00		25,000.00
49	Pennsylvania.....	25,637.43		25,000.00	5,382.57	85,960.17
50	Rhode Island.....	2,500.00		25,000.00		25,000.00
51	South Carolina (Clemson College).....	5,754.00		12,500.00	150,323.48	
52	South Carolina (Orangeburg).....			12,500.00		6,360.00
53	South Dakota.....	14,558.90		25,000.00		34,900.00
54	Tennessee.....	23,960.00	250.00	25,000.00		
55	Texas (College Station).....	14,280.00		18,750.00		73,085.00
56	Texas (Prairie View).....			6,250.00		19,000.00
57	Utah.....	8,353.34		25,000.00		65,000.00
58	Vermont.....	8,130.00		25,000.00	2,600.00	6,000.00
59	Virginia (Blacksburg).....	20,658.00		16,666.67		55,000.00
60	Virginia (Hampton).....	10,329.36		8,333.33		
61	Washington.....			25,000.00		108,627.00
62	West Virginia (Morgantown).....	4,500.00		20,000.00	1,000.00	122,000.00
63	West Virginia (Institute).....			5,000.00		1,800.00
64	Wisconsin.....	12,662.57	13,111.67	25,000.00		622,085.00
65	Wyoming.....	3,809.93	3,697.60	25,000.00		22,154.75
	Total.....	741,820.56	131,561.10	1,200,000.00	270,008.50	4,561,496.90

a Insurance.

b Including \$15,000 for agricultural extension work.

c Including tuition fees.

d Including tuition and incidental fees.

for year ended June 30, 1907.

State aid.	Income from endowment other than Federal or State grants.	Fees and all other sources.			Total.	United States appropriations for experiment stations (acts of 1887 and 1906).	
		Tuition fees.	Incidental fees.	Miscellaneous.			
\$1,500.00		\$1,390.00	\$4,000.00	\$4,000.00	\$76,895.00	\$22,000.00	1
		1,182.51			16,457.51		2
40,000.00		460.00	505.00	4,075.00	102,040.00	22,000.00	3
50,000.00			6,286.50	308.00	153,676.32	22,000.00	4
		600.00			21,918.18		5
312,059.92	\$96,478.28	3,195.00	70,554.41	309,206.74	1,299,645.14	22,000.00	6
				12,590.03	125,699.34	22,000.00	7
18,000.00	3,113.27		294.35	40,298.24	113,455.86	11,000.00	8
20,000.00		420.00	4,280.00	1,652.67	51,332.67	22,000.00	9
3,000.00				5,945.00	13,945.00		10
		40.00	471.67	80.00	31,751.67	22,000.00	11
				437.11	15,937.11		12
		1,670.00	451.00	1,950.94	37,692.75		13
					16,333.33		14
				108,500.00	172,750.00	22,000.00	15
272,500.00			215,167.64	84,931.74	980,009.00	22,000.00	16
58,623.77		10,637.50	51,190.00	10,503.97	328,592.63	22,000.00	17
210,736.09		1,932.00	45,332.44	1,450.46	480,281.08	22,000.00	18
30,890.75			13,129.00	37,704.45	236,535.82	22,000.00	19
		5,097.00	3,437.50	1,736.31	82,898.12	22,000.00	20
			200.00	4,827.40	18,007.90		21
16,600.00		2,085.00	2,625.50	12,341.10	86,365.91	22,000.00	22
1,500.00				505.07	23,846.45		23
	4,000.00	20,000.00	10,008.00	4,700.00	109,623.00	22,000.00	24
42,000.00		24,953.80	10,826.50	3,438.31	122,015.77	22,000.00	25
	815.02		1,728.00	1,328.28	8,871.30		26
		728.67	1,473.40	34,065.91	106,631.28	22,000.00	27
	73,152.00	313,816.25	11,936.36	152,948.37	590,493.00		28
152,431.36		970.00	5,557.50	46,178.05	370,292.13	22,000.00	29
569,094.24	50,000.00	143,045.22		30,302.63	1,136,100.07	22,000.00	30
	250.00	750.00	4,192.00	99,453.04	197,307.95	22,000.00	31
		35.00			43,288.07		32
10,000.00					518,658.57	22,000.00	33
94,522.46	300.00		30,786.60	55,627.30	28,762.50		34
		2,136.00	1,583.00	5,516.00	106,235.00	22,000.00	35
40,000.00		11,450.00	9,461.00	49,279.43	446,276.43	22,000.00	36
103,735.00	1,000.00			2,769.19	151,360.62	22,000.00	37
30,000.00	62.00			36,760.79	121,316.71	22,000.00	38
32,888.00	3,252.00	3,603.50	2,012.42	1,379.39	112,510.51	22,000.00	39
25,000.00	23,057.95		13,673.17	8,198.73	48,765.20	22,000.00	40
		2,258.50		280,349.02	1,250,742.82	19,800.00	41
7,500.00	374,200.71	319,346.80	92,417.49	32,899.39	116,621.34	22,000.00	42
2,000.00		14,075.50	12,896.45	8,455.79	26,610.40		43
108,000.00		234.40	170.21	7,593.23	222,726.76	22,000.00	44
80,693.48	10,979.00	51,544.97	4,032.32	49,325.13	612,491.45		45
300.00			1,892.50	43,815.16	106,844.08	22,000.00	46
					33,793.00		47
			3,917.50	9,794.52	75,011.78	22,000.00	48
39,018.00		540.00	24,698.69	44,759.24	250,996.10	22,000.00	49
3,639.00		742.26	990.00	9,593.18	67,464.44	22,000.00	50
	3,512.36	2,272.00	4,652.39	62,334.03	241,348.26	22,000.00	51
					26,054.00		52
1,500.00		4,100.00	3,500.95	10,766.17	92,826.02	22,000.00	53
50,000.00	2,338.00	16,571.25		13,757.34	131,876.59	22,000.00	54
10,000.00			2,200.00	1,000.00	119,315.00	22,000.00	55
		3,378.00	2,350.00	25,000.00	52,600.00		56
47,788.00		1,753.24	14,557.46	14,557.46	165,830.04	22,000.00	57
60,000.00	28,777.55	30,980.92	4,345.51	165,833.98	22,000.00	22,000.00	58
25,000.00		2,770.00	5,387.16	155,932.50	22,000.00	22,000.00	59
	69,250.55			122,832.74	210,745.98		60
185,250.00		290.00	3,689.35	14,474.10	337,330.45	22,000.00	61
21,000.00				187,750.00	187,250.00	22,000.00	62
28,000.00			214.00	1,210.00	36,224.00		63
200,000.00	3,237.75	21,391.50	58,959.50	144,520.90	1,100,968.89	22,000.00	64
7,158.79	27.00	1,029.50	46.98	5,601.41	68,525.96	22,000.00	65
3,011,928.86	747,803.44	1,021,723.05	769,985.20	2,104,211.13	14,560,538.74	998,800.00	



Oklahoma (Stillwater)	75,000.00	1,433.88	9,727.52	6,636.97	5,309.00	1,000.00	99,107.37
Oklahoma (Langston)		150.00	300.00	30.75	65.00		545.75
Oregon		706.91	1,422.04	1,461.47	752.20	324.51	75,667.13
Pennsylvania		2,200.00					6,667.00
Rhode Island		4,475.00					25,887.86
South Carolina (Clemson College)		15,000.00					66,840.97
South Carolina (Orangeburg)		56,844.82					3,500.00
South Dakota		3,800.00					11,750.00
Tennessee		2,000.00					33,782.61
Texas (College Station)		24,075.79					10,000.00
Texas (Prairie View)							250.00
Utah		24,816.21					37,272.28
Vermont		60,000.00					85,242.50
Virginia (Blacksburg)	16,297.50	2,645.00	2,429.14	2,146.73	1,900.46	4,023.30	51,404.04
Virginia (Hampton)		35,404.04					135,514.24
Washington	94,468.24	32,000.00					2,850.00
West Virginia (Morgantown)		16,000.00					31,000.00
West Virginia (Institute)		15,000.00					6,500.00
Wisconsin		117,439.76					101,848.30
Wyoming		25,000.00					33,156.56
Total	1,303,030.26	2,980,700.87	203,917.50	143,466.71	96,300.87	242,841.84	5,269,749.49

<sup>a</sup> Including machinery.<sup>b</sup> Including apparatus and machinery.



Utah.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000
Vermont.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000
Virginia.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000
Washington.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000
West Virginia.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000
Wisconsin.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000
Wyoming.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	30,000
Total.....	660,000	704,000	782,000	864,000	912,000	960,000	1,008,000	1,056,000	1,104,000	1,152,000	1,200,000	1,440,000

<sup>a</sup> From the annual statement of Commissioner of Education to the Secretary of the Interior, 1906.

<sup>b</sup> For each of the years ended June 30, 1901, 1902, 1903, 1904, 1905, 1906, and 1907 the sum of \$25,000 was paid to each of the 48 States and Territories included in this tabular statement, the total amount disbursed for each of said years being \$1,200,000.



## STATISTICS OF AGRICULTURAL

TABLE 8.—General

Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
Alabama (College).....	Auburn.....	J. F. Duggar, M. S. . .	Feb. —, 1883	Feb. 24, 1888
Alabama (Canebrake) . .	Uniontown.....	F. D. Stevens, B. S. . .	Jan. 1, 1886	Apr. 1, 1888
Alabama.....	Tuskegee Institute.	G. W. Carver, M. S. Agr.	Feb. 15, 1897	.....
Arizona.....	Tucson.....	R. H. Forbes, M. S. . .	.....	1899
Arkansas.....	Fayetteville.....	W. G. Vincenheller.....	.....	Mar. 7, 1899
California.....	Berkeley.....	E. J. Wickson, A. M. . .	1873	Mar. —, 1888
Colorado.....	Fort Collins.....	L. G. Carpenter, M. S. .	.....	Feb. —, 1888
Connecticut (State).....	New Haven.....	E. H. Jenkins, Ph. D. .	Oct. 1, 1875	May 18, 1887
Connecticut (Storrs).....	Storrs.....	L. A. Clinton, M. S. . .	.....	do.....
Delaware.....	Newark.....	H. Hayward, M. S. Agr.	.....	Feb. 21, 1888
Florida.....	Gainesville.....	P. H. Rolfs, M. S. . . .	.....	1888
Georgia.....	Experiment.....	M. V. Calvin.....	Feb. 18, 1888	July 1, 1899
Idaho.....	Moscow.....	H. T. French, M. S. . .	.....	Feb. 26, 1892
Illinois.....	Urbana.....	Eugene Davenport, LL. D.	.....	Mar. 21, 1888
Indiana.....	Lafayette.....	Arthur Goss, M. S., A. C.	1885	Jan. —, 1888
Iowa.....	Ames.....	C. F. Curtiss, M. S. A. .	.....	Feb. 17, 1888
Kansas.....	Manhattan.....	C. W. Burkett, M. S. . .	.....	Feb. 8, 1888

## EXPERIMENT STATIONS.

statistics, 1907.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1906-7.		Number of names on mailing list.	Principal lines of work.
			Number.	Pages.		
17	13	10	7	240	15,800	Field experiments; plant breeding; soil improvement; feeding experiments; entomology; diseases of plants and animals; analyses of fertilizers.
1	-----	-----	1	21	1,800	Soil improvement; field experiments; horticulture; floriculture; plant breeding; diseases of plants.
13	10	10	2	16	1,600	Field experiments; horticulture; plant breeding; diseases of plants; animal industry; poultry investigations; dairying.
10	-----	3	9	160	6,300	Chemistry; botany; field experiments; improvement of ranges; horticulture, including date-palm culture; feeding and breeding experiments; plant diseases; irrigation.
14	10	10	5	230	15,000	Chemistry; soil physics; field experiments; horticulture; plant breeding; diseases of plants and animals; feeding and breeding experiments; entomology; nursery inspection; dairying; poultry experiments.
42	21	16	23	415	11,000	Chemistry; soils; bacteriology; fertilizer control; field crops; horticulture, including date culture, viticulture, and zymology; botany; meteorology; animal husbandry; entomology; dairying; poultry culture; drainage and irrigation; silviculture; reclamation of alkali lands; animal and plant pathology; nutrition investigations.
24	13	14	7	162	15,600	Chemistry; meteorology; field experiments; horticulture; forestry; plant breeding; diseases of plants; animal husbandry; veterinary investigations; entomology; irrigation.
17	-----	5	7	506	8,500	Chemistry; analysis and inspection of fertilizers, foods, and feeding stuffs; inspection of Babcock test apparatus and nurseries; diseases of plants; plant selection and breeding; forestry; field experiments; entomology; investigation of vegetable proteids.
11	6	5	7	344	9,000	Bacteriology of dairy products; field experiments; horticulture; feeding and breeding experiments; poultry experiments; dairying.
9	8	8	7	261	6,886	Chemistry; mycology; field experiments; horticulture; plant breeding; diseases of plants and animals; entomology.
14	-----	-----	5	284	4,500	Chemistry; field experiments; horticulture; diseases of plants; feeding experiments; veterinary science; entomology.
10	1	9	6	132	15,994	Chemistry; field experiments; bacteriology; horticulture; plant breeding; plant diseases; entomology; feeding experiments; dairying.
10	3	6	6	211	6,000	Chemistry; physics; botany; field experiments; horticulture; plant breeding and diseases; entomology; animal husbandry; irrigation; dairying; dry farming; wheat investigations; fruit by-products.
44	22	22	16	426	37,000	Chemistry; soil physics; bacteriology; pot and field experiments; horticulture; forestry; plant breeding; animal husbandry; diseases of plants and animals; dairying.
33	11	15	17	389	18,276	Chemistry; soils; pot and field experiments; horticulture; plant breeding; feeding stuff and fertilizer control; breeding and feeding experiments; diseases of plants and animals; entomology; dairying; agricultural extension work.
27	16	9	8	258	17,500	Chemistry; botany; soils; field experiments; horticulture; plant breeding; forestry; diseases of plants; animal husbandry; poultry investigations; entomology; dairying; rural engineering; good roads investigations.
27	16	9	9	334	24,711	Chemistry; soils; inspection of feeding stuffs and fertilizers; horticulture; plant breeding; field experiments; feeding and digestion experiments; poultry experiments; diseases of animals; entomology; dairying; extermination of prairie dogs and gophers; irrigation.

TABLE 8.—General

Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
Kentucky.....	Lexington.....	M. A. Scovell, Ph. D..	Sept. —, 1885	Apr. —, 1888
Louisiana (Sugar).....	New Orleans.....	W. R. Dodson, B. A., B. S.	Sept. —, 1885	
Louisiana (State).....	Baton Rouge.....	do.....	Apr. —, 1886	
Louisiana (North).....	Calhoun.....	do.....	May —, 1887	
Maine.....	Orono.....	C. D. Woods, Sc. D...	Mar. —, 1885	Oct. 1, 1887
Maryland.....	College Park.....	H. J. Patterson, B. S.	1888	Apr. —, 1888
Massachusetts.....	Amherst.....	W. P. Brooks, Ph. D.	1882	Mar. 2, 1888
Michigan.....	East Lansing.....	C. D. Smith, M. S.....		Feb. 26, 1888
Minnesota.....	St. Anthony Park....	E. W. Randall.....	Mar. 7, 1885	1888
Mississippi.....	Agricultural College..	W. L. Hutchinson, M. S.		Jan. 27, 1888
Missouri (College).....	Columbia.....	H. J. Waters, B. S. A.		Jan. —, 1888
Missouri (Fruit).....	Mountain Grove.....	Paul Evans.....	Feb. 1, 1900	
Montana.....	Bozeman.....	F. B. Linfield, B. S. A.		July 1, 1893
Nebraska.....	Lincoln.....	E. A. Burnett, B. S...	Dec. 16, 1884	June 13, 1887
Nevada.....	Reno.....	J. E. Stubbs, D. D., LL. D.		Dec. —, 1887
New Hampshire.....	Durham.....	E. D. Sanderson, B. S. A.		Aug. 4, 1887
New Jersey (State).....	New Brunswick.....	E. B. Voorhies, D. Sc.	Mar. 10, 1880	
New Jersey (College).....	do.....	do.....		Apr. 26, 1888

In 1885  
closed

at a station here and maintained it until June 18, 1895, when it was com-  
at the same place.

statistics, 1907—Continued.

Num- ber on staff.	Num- ber of teachers on staff.	Num- ber of persons on staff who assist in farm- ers' insti- tutes.	Publications during fiscal year 1906-7.		Num- ber of names on mail- ing list.	Principal lines of work.
			Num- ber.	Pages.		
20	.....	6	5	222	11,200	Chemistry; soils; inspection of fertilizers, foods, feed- ing stuffs, seeds, orchards, and nurseries; field ex- periments; horticulture; plant breeding; animal husbandry; diseases of plants; entomology; apicul- ture; dairying. (Chemistry; bacteriology; soils; field experiments; hor- ticulture; sugar making; drainage; irrigation. Geology; botany; bacteriology; soils; inspection of fertilizers, feeding stuffs, and Paris green; field ex- periments; horticulture; animal husbandry; dis- eases of animals; entomology. Chemistry; soils; fertilizers; field experiments; hor- ticulture; feeding experiments; stock raising; poul- try experiments; dairying.
27	2	.....	10	450	11,500	Chemistry; botany; analysis and inspection of foods, fertilizers, concentrated commercial feeding stuffs, and agricultural seeds; inspection of creamery glass- ware; mycology; nutrition investigations; poultry breeding; plant breeding; entomology. Chemistry; fertilizers; field experiments; horticul- ture; plant breeding; diseases of plants and ani- mals; feeding experiments; animal breeding; poul- try raising; entomology; dairying.
17	1	.....	15	684	11,000	Chemistry; meteorology; analysis and inspection of fertilizers and concentrated commercial feeding stuffs; inspection of creamery glassware and nur- series; pot, cylinder, and field experiments; hor- ticulture; plant breeding; diseases of plants and ani- mals; digestion and feeding experiments; entomol- ogy; dairying; effect of electricity on plant growth.
18	4	11	10	327	22,000	Chemistry; analysis and control of fertilizers; bacte- riology; field experiments; horticulture; plant breeding; diseases of plants and animals; feeding and breeding experiments; entomology; stable hy- giene.
30	9	6	27	504	20,973	Chemistry; soils; fertilizers; field experiments; hor- ticulture; forestry; diseases of plants and animals; food and nutrition of man; plant and animal breed- ing; animal nutrition; entomology; dairying; farm management; farm statistics.
19	18	.....	12	178	44,500	Fertilizers; field experiments; horticulture; biology; plant breeding; animal husbandry; diseases of ani- mals; poultry culture; entomology; dairying; agri- cultural engineering.
24	6	.....	5	714	14,000	Chemistry; soil survey; botany; field experiments; horticulture; diseases of plants and animals; feed- ing experiments; animal and plant breeding; ento- mology; dairying.
17	9	12	10	240	22,000	Horticulture; vegetable pathology; entomology; in- spection of orchards and nurseries.
37	17	10	4	212	8,000	Chemistry; meteorology; botany; field experiments; dry farming; horticulture; feeding and breeding ex- periments; poultry experiments; entomology; dairying; irrigation and drainage.
6	.....	.....	2	56	6,000	Chemistry; botany; meteorology; soils; field experi- ments; horticulture; plant breeding; diseases of plants and animals; forestry; feeding and breeding experiments; entomology; dairying; irrigation.
12	12	11	5	180	6,000	Chemistry; meteorology; botany; soils; field experi- ments; horticulture; plant breeding; forestry; ani- mal feeding and breeding; plant and animal diseases; veterinary science and bacteriology; zoology; ento- mology; irrigation.
26	18	10	7	196	17,500	Chemistry; botany; field experiments; horticulture; plant breeding; breeding experiments; entomology; dairying.
12	6	3	4	164	3,500	Chemistry; oyster culture; botany; analysis of fer- tilizers, foods, and commercial feeding stuffs; pot, cylinder, and field experiments; horticulture; plant breeding; diseases of plants and animals; entomol- ogy; dairy husbandry; soil chemistry and bacte- riology; irrigation.
14	9	5	6	166	15,000	
15	2	4	7	507	6,650	
12	5	3	5	517		

TABLE 8.—*General*

Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
New Mexico.....	Agricultural College..	Luther Foster, M. S. A.	.....	Dec. 14, 1889
New York (State).....	Geneva.....	W. H. Jordan, D. Sc., LL. D.	Mar. —, 1882	.....
New York (Cornell) ....	Ithaca.....	L. H. Bailey, M. S., LL. D.	1879	Apr. —, 1888
North Carolina (College)	West Raleigh.....	C. B. Williams, M. S.	Mar. 12, 1877	Mar. 7, 1887
North Carolina (State)..	Raleigh.....	B. W. Kilgore, M. S.	1906	.....
North Dakota.....	Agricultural College..	J. H. Worst, LL. D.	.....	Mar. —, 1890
Ohio.....	Wooster.....	C. E. Thorne, M. S. A.	Apr. 25, 1882	Apr. 2, 1888
Oklahoma.....	Stillwater.....	W. L. English, B. S.	.....	Dec. 25, 1890
Oregon.....	Corvallis.....	James Withycombe, M. Agr.	.....	July —, 1888
Pennsylvania.....	State College.....	T. F. Hunt, D. Agr., D. Sc.	.....	June 30, 1887
Rhode Island.....	Kingston.....	H. J. Wheeler, Ph. D.	.....	July 30, 1888
South Carolina.....	Clemson College.....	J. N. Harper, M. Agr.	.....	Jan. —, 1888
South Dakota.....	Brookings.....	J. W. Wilson, M. S. A.	.....	Mar. 13, 1887
Tennessee.....	Knoxville.....	H. A. Morgan, B. S. A.	June 8, 1882	Aug. 4, 1887
Texas.....	College Station.....	H. H. Harrington, LL. D.	.....	.....
Utah.....	Logan.....	E. D. Ball, Ph. D.	.....	1890

statistics, 1907—Continued.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1906-7.		Number of names on mailing list.	Principal lines of work.
			Number.	Pages.		
18	14	14	6	371	3,500	Chemistry; botany; soils; field experiments; dry farming; horticulture; cactus and guayule plant investigations; feeding experiments; entomology; dairying; irrigation.
31	.....	9	27	1,118	44,000	Chemistry; bacteriology; meteorology; fertilizers; analysis and control of fertilizers; inspection of feeding stuffs, Paris green, and creamery glassware; field experiments; horticulture; plant breeding; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; irrigation.
24	19	.....	8	554	20,000	Chemistry; soils; field experiments; horticulture; plant breeding; diseases of plants; feeding and breeding experiments; poultry experiments; entomology; dairying.
13	9	6	3	114	33,000	Chemistry; soils; field experiments; horticulture; diseases of plants and animals; animal husbandry; poultry experiments; dairying; tests of farm machinery.
20	.....	.....	.....	.....	.....	Chemistry; soils; field experiments; horticulture; diseases of animals; feeding experiments; entomology; fertilizer experiments and analyses; inspection of foods and stock feeds; cooperative demonstration work with farmers; farmers' institutes.
22	14	5	11	539	12,500	Chemistry; soils; botany; field experiments; plant breeding; horticulture; forestry; diseases of plants and animals; analysis of foods and spraying materials; inspection and analysis of paints, drugs, proprietary products and feeding stuffs; feeding and breeding experiments; poultry experiments; milling and chemical tests of wheat; drainage.
33	.....	10	16	308	32,000	Chemistry; soils; field experiments; botany; horticulture; plant breeding; forestry; diseases of plants; feeding experiments; entomology.
13	10	6	5	120	23,560	Chemistry; field experiments; horticulture; plant and animal breeding; forestry; botany; bacteriology; diseases of plants and animals; animal husbandry; entomology.
19	5	3	6	224	6,000	Chemistry; bacteriology; soils; fertilizers; field crops; horticulture; plant breeding and selection; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; irrigation.
35	17	7	4	50	17,500	Chemistry; meteorology; fertilizers; horticulture; plant diseases; field experiments; feeding experiments; dairying; poultry experiments.
14	4	7	8	188	9,487	Chemistry; meteorology; soils; analysis and inspection of fertilizers and feeding stuffs; field and pot experiments; horticulture; plant breeding; poultry experiments.
21	13	8	9	179	13,500	Chemistry; analysis and control of fertilizers; soils; botany; field experiments; horticulture; plant breeding; diseases of plants; feeding and breeding experiments; veterinary science; entomology; dairying.
15	11	5	6	202	15,000	Chemistry; botany; horticulture; field experiments; plant breeding; diseases of plants and animals; animal husbandry; entomology; dairying.
22	10	6	4	90	12,000	Chemistry; soil investigations; inspection of fertilizers; field experiments; horticulture; plant breeding; seeds; weeds; diseases of plants and animals; feeding experiments; entomology; dairying; poultry investigations; apiculture.
19	6	5	11	179	30,000	Chemistry; seed testing and feed inspection; botany and mycology; soils; field experiments; horticulture; plant breeding; feeding experiments; diseases of plants and animals; entomology; irrigation.
22	14	7	9	356	6,700	Chemistry of soils; field experiments; horticulture; diseases of plants and animals; breeding and feeding experiments; dairying; poultry experiments; entomology; irrigation; arid farming.

TABLE 8.—*General*

Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
Vermont.....	Burlington.....	J. L. Hills, Sc. D.....	Nov. 24, 1886	Feb. 28, 1888
Virginia.....	Blacksburg.....	S. W. Fletcher, Ph. D.....		Oct. 16, 1888
Washington.....	Pullman.....	R. W. Thatcher, B. S., M. A.		1891
West Virginia.....	Morgantown.....	J. H. Stewart, M. A.....		June 11, 1888
Wisconsin.....	Madison.....	H. L. Russell, Ph. D.....	1883	1887
Wyoming.....	Laramie.....	J. D. Towar, M. S.....		Mar. 1, 1891
Total.....				

statistics, 1907—Continued.

Number on staff.	Number of teachers on staff.	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1906-7.		Number of names on mailing list.	Principal lines of work.
			Number.	Pages.		
17	7	6	3	43	14,000	Chemistry; botany; bacteriology; analysis and control of fertilizers and feeding stuffs; inspection of creamery glassware; State nursery for forest-tree seedlings; horticulture; diseases of plants; feeding and breeding experiments; dairying.
24	9	5	8	374	13,000	Chemistry; geology; biology; field experiments; horticulture; plant breeding; bacteriology; mycology; analysis of foods and soils; inspection of orchards; breeding and feeding experiments; veterinary science; entomology; cider and vinegar making; ferments; dairying.
17	13	12	6	150	4,568	Chemistry; botany; bacteriology; soils; field experiments; horticulture; plant breeding; diseases of plants; feeding and breeding experiments; veterinary science; entomology; dairying; irrigation; dry farming.
14	4	6	5	165	3,700	Chemistry; effect of pressure in the preservation of fruits, vegetables, and milk; artificial fixation of atmospheric nitrogen; analysis and control of fertilizers; soils; field experiments; horticulture; diseases of plants and animals; inspection of orchards and nurseries; animal husbandry; feeding and breeding experiments; poultry experiments; entomology; dairying.
44	29	5	16	980	21,000	Chemistry; bacteriology; soils; field experiments; agronomy; tobacco and cranberry culture; horticulture; plant breeding; breeding and feeding experiments; dairying; irrigation and drainage; agricultural engineering.
12	8	5	7	191	4,500	Chemistry; mycology; botany; meteorology; soils; range improvement; fertilizers; field experiments; plant selection; food analysis; breeding and feeding experiments; wool investigation; irrigation.
1,098	484	374	450	16,917	774,805	



TABLE 9.—Revenue and

	Station.	Federal.		State.	Individuals and communities.	Fees.	Farm products.
		Hatch fund.	Adams fund.				
1	Alabama (College).....	\$15,000.00	\$7,000.00	\$12,169.45			\$329.51
2	Alabama (Canebrake).....			2,500.00			770.78
3	Alabama (Tuskegee).....			1,500.00			80.00
4	Arizona.....	15,000.00	7,000.00	<sup>a</sup> 6,349.20	\$2,500.00	\$98.30	1,802.87
5	Arkansas.....	15,000.00	7,000.00	8,063.57			5,339.68
6	California.....	15,000.00	7,000.00	79,628.48	490.98	9,593.34	1,531.10
7	Colorado.....	15,000.00	7,000.00				
8	Connecticut (State).....	7,500.00	3,500.00	16,500.00	8,300.00	3,900.00	
9	Connecticut (Storrs).....	7,500.00	3,500.00	1,800.00			
10	Delaware.....	15,000.00	7,000.00	67.01			14.07
11	Florida.....	15,000.00	7,000.00	19,524.26		55.00	550.74
12	Georgia.....	15,000.00	7,000.00	780.84			2,378.99
13	Idaho.....	15,000.00	7,000.00				1,533.49
14	Illinois.....	15,000.00	7,000.00	95,000.00		842.00	22,604.17
15	Indiana.....	15,000.00	7,000.00	22,916.67			
16	Iowa.....	15,000.00	7,000.00	35,194.62		30.00	849.19
17	Kansas.....	15,000.00	7,000.00	<sup>c</sup> 12,500.00		3,170.00	<sup>f</sup> 11,425.51
18	Kentucky.....	15,000.00	7,000.00			<sup>c</sup> 8,791.27	6,905.14
19	Louisiana.....	15,000.00	7,000.00	10,000.00		9,300.00	7,191.18
20	Maine.....	15,000.00	7,000.00				
21	Maryland.....	15,000.00	7,000.00	18,303.17			6,365.63
22	Massachusetts.....	15,000.00	7,000.00	16,500.00		4,745.00	1,267.21
23	Michigan.....	15,000.00	7,000.00	21,350.00		2,840.00	<sup>f</sup> 3,358.84
24	Minnesota.....	15,000.00	7,000.00	<sup>f</sup> 49,024.27			<sup>f</sup> 12,774.35
25	Mississippi.....	15,000.00	7,000.00	<sup>c</sup> 37,000.00			<sup>f</sup> 5,748.46
26	Missouri (College).....	15,000.00	7,000.00	3,621.04		5,407.10	7,263.03
27	Missouri (Fruit).....						
28	Montana.....	15,000.00	7,000.00	9,790.14	2,401.82		5,982.68
29	Nebraska.....	15,000.00	7,000.00	<sup>f</sup> 10,175.00			17,905.47
30	Nevada.....	15,000.00	7,000.00				2,569.19
31	New Hampshire.....	15,000.00	7,000.00			2,012.42	
32	New Jersey (State).....			48,500.00			
33	New Jersey (College).....	15,000.00	7,000.00				
34	New Mexico.....	15,000.00	7,000.00				2,170.93
35	New York (State).....	1,500.00	700.00	88,000.00			
36	New York (Corn II).....	13,500.00	6,300.00				
37	North Carolina (College).....	15,000.00	7,000.00	<sup>a</sup> 17,000.00			696.78
38	North Dakota.....	15,000.00	7,000.00	7,500.00	1,500.00		1,143.49
39	Ohio.....	15,000.00	7,000.00	51,200.00		17.00	12,429.90
40	Oklahoma.....	15,000.00	7,000.00	2,500.00			
41	Oregon.....	15,000.00	7,000.00				
42	Pennsylvania.....	15,000.00	7,000.00	8,164.95		13,188.00	2,187.95
43	Rhode Island.....	15,000.00	7,000.00				
44	South Carolina.....	15,000.00	7,000.00				
45	South Dakota.....	15,000.00	7,000.00	1,000.00			
46	Tennessee.....	15,000.00	7,000.00			1,015.00	7,487.54
47	Texas.....	15,000.00	7,000.00	<sup>c</sup> 10,000.00			
48	Utah.....	15,000.00	7,000.00	<sup>f</sup> 18,666.16			5,424.34
49	Vermont.....	15,000.00	7,000.00	1,727.51	167.77	2,968.70	
50	Virginia.....	15,000.00	7,000.00	5,000.00			103.65
51	Washington.....	15,000.00	7,000.00				1,164.50
52	West Virginia.....	15,000.00	7,000.00	2,000.00		8,547.64	5,251.46
53	Wisconsin.....	15,000.00	7,000.00	18,500.00		2,950.00	
54	Wyoming.....	15,000.00	7,000.00				4,951.41
Total.....		720,000.00	336,000.00	770,016.34	15,360.57	119,470.77	169,553.23

<sup>a</sup> Including balance from previous year.<sup>b</sup> Including land.<sup>c</sup> Including all balances.<sup>d</sup> Balance from previous year.

additions to equipment, 1907.

		Additions to equipment, 1907.							
Miscel- laneous.	Total.	Buildings.	Libra- ries.	Appa- ratus.	Farm im- plements.	Live stock.	Miscel- laneous.	Total.	
\$1,449.28	\$35,948.24	\$700.00	\$500.00	\$1,300.00	\$250.00	\$213.00	\$527.00	\$3,490.00	
716.25	3,987.03	263.10			171.70	400.00	110.00	944.80	
	1,580.00			100.00	75.00			175.00	
1,486.19	34,236.56	521.33	19.04	278.14	341.22	313.50	537.66	2,010.89	
	35,403.25	2,352.48	297.45	476.70	120.45	787.43	803.98	4,838.49	
25,621.32	138,865.22	35,000.00	299.97	1,301.43	2,952.12	3,977.25	392.31	43,923.08	
c9,862.20	31,862.20	853.91	660.06	463.77	47.50	533.30	183.94	2,742.48	
e950.74	40,650.74	927.29	602.94	477.28	23.28		131.85	2,152.64	
e1,657.35	14,457.35	691.52	135.15	385.36	30.61	459.00	428.15	2,129.79	
809.07	22,890.15	329.19	223.53	127.25	687.25			1,367.22	
	42,130.00	3,631.00	687.24	627.02	613.54		1,799.30	7,358.10	
a4,114.36	29,274.19	2,653.58	66.24	4.50	204.02	61.50	99.50	3,039.34	
d243.46	25,776.95	774.25	724.10	358.32	1,628.39	341.05	88.12	3,914.23	
1,861.57	142,307.74	10,000.00	95.65	1,597.00	1,245.00	10,415.00	548.76	23,901.41	
25,151.65	70,068.32	2,057.99	723.76	2,508.64	1,469.24	5,631.08	50,760.94	72,151.65	
10,262.08	68,335.89	6,000.00		220.31	226.46	3,145.30		9,592.07	
a3,367.27	52,462.78	892.02	59.29	420.50	300.00	1,000.00	475.00	3,146.81	
1,314.36	79,010.77	1,571.05	547.67	1,264.39	345.57	707.00	9,350.65	13,786.33	
d7,001.13	55,492.31	4,928.50	212.88	1,076.42	951.48	1,729.40		8,898.68	
a14,963.52	36,963.52	1,800.00	1,900.00	1,000.00				4,700.00	
	46,668.80	3,400.00	316.26	966.93	570.15	662.50	120.73	6,036.57	
6,800.42	51,312.63		1,000.00	1,019.74	164.33			2,184.07	
d4,130.01	53,678.85	62.82	442.13	659.48	113.95	164.40		1,442.78	
	83,798.62		80.00	2,484.40	1,380.95	2,057.65	648.80	6,651.80	
	64,748.46	500.00		100.00		8,025.00		8,625.00	
d161.48	38,452.65	757.33	145.17	2,364.60	107.42	455.00	25.75	3,855.27	
	40,174.64		300.00	1,158.00	1,022.00	700.00	260.00	3,440.00	
d6,749.64	56,830.11			1,498.66	1,005.01	1,746.44	2,139.96	6,390.07	
a982.42	25,551.61	745.54	2,371.26	1,735.31	772.47	1,893.60	2,389.56	9,907.74	
	24,012.42		229.06	841.85	448.90	297.67		1,817.48	
	48,500.00		57.25	1,040.35			222.25	1,319.85	
	22,000.00	741.44	888.80	1,072.17	116.94		246.39	3,065.74	
1,190.79	25,361.72			8.65	1,169.86	337.00	475.70	1,991.21	
a4,991.63	95,191.63		851.42	500.00	500.00	516.00		2,367.42	
	19,800.00								
173.86	39,870.64	1,126.64	313.12	747.26	493.05	655.00	600.00	3,935.07	
4,425.97	36,569.46	6,312.50	52.23	1,229.25	268.16	2,689.80	469.15	11,021.09	
f40,409.16	126,056.06	6,703.47	670.58	955.25	856.21	3,769.25		12,954.76	
4,338.42	28,838.42	447.48	61.96	60.29	422.01	257.76	50.60	1,900.10	
a2,339.57	24,339.57	522.36	352.16	1,386.60	621.83			2,882.95	
145.68	45,686.58		2,047.00	3,200.00	82.20	2,384.40	450.85	8,164.45	
4,877.90	26,877.90	1,120.29	550.38	199.47	195.19	183.50	631.84	2,880.67	
a3,371.72	25,371.72		84.34	626.77	497.19	2,166.25	63.41	3,437.96	
2,958.81	25,958.81	2,408.01	100.00	741.11	556.06		45.00	3,850.18	
496.46	30,999.00	125.00	652.43	1,384.62	996.47	60.00	689.88	3,908.40	
1,335.86	33,335.86	939.60	348.42	697.40	155.77	1,151.00	287.09	3,579.28	
d2,930.65	49,021.15	1,008.77	177.89	670.82	1,215.98	1,283.31	2,147.82	6,504.59	
	26,863.98	168.63	200.45	807.03	208.90	537.50		1,922.61	
628.74	27,732.39	260.79	480.80	2,497.26	25.66	200.00	358.20	3,822.71	
	23,164.50			86.00	24.60			110.60	
	37,799.10	3,000.00	505.92	2,713.51	731.75	552.50	132.50	7,636.18	
	43,450.00	3,354.64	876.56	2,160.81	928.48	555.90	461.39	8,337.78	
	26,951.41	25,000.00	350.00	154.60	2,078.65	422.22	50.00	28,055.47	
204,270.99	2,334,671.90	134,273.33	22,366.22	49,841.50	28,852.97	64,124.71	88,204.03	387,662.76	

c For substations.

f Including substations.

g Balance of State appropriation from previous year.

h Estimated amount of State appropriation spent for experimental purposes during fiscal year ended December 1, 1907.

i Including balance of \$38,031.40 from State appropriation from previous year.

TABLE 10.—*Expenditures from United States appropriation of March 2, 1887,*

	Station.	Amount of appropriation.	Classified expenditures.						
			Salaries.	Labor.	Publications.	Postage and stationery.	Freight and express.	Heat, light, and water.	Chemical supplies.
1	Alabama.....	\$15,000.00	\$7,653.33	\$1,425.17	\$1,132.25	\$303.29	\$395.35	\$404.57	\$650.51
2	Arizona.....	15,000.00	7,314.81	2,157.01	479.01	568.83	707.20	112.77	235.89
3	Arkansas.....	15,000.00	8,613.48	1,631.73	613.10	325.90	535.68	268.28	76.64
4	California.....	15,000.00	7,170.00	4,526.84	879.21	569.20	98.06	119.05	53.69
5	Colorado.....	15,000.00	9,111.27	1,200.34	1,914.26	616.07	522.23	5.90	.....
6	Connecticut (State)	7,500.00	7,500.00	.....	.....	.....	.....	.....	.....
7	Connecticut (Storrs)	7,500.00	4,306.62	1,013.13	75.69	283.86	90	53.34	299.57
8	Delaware.....	15,000.00	8,106.33	1,346.97	1,313.48	153.28	157.92	65.41	149.70
9	Florida.....	15,000.00	6,650.14	2,300.68	718.60	287.35	226.34	149.20	29.75
10	Georgia.....	15,000.00	6,935.00	3,061.00	1,146.73	198.24	314.58	281.50	.....
11	Idaho.....	15,000.00	6,608.22	2,976.63	1,607.25	242.28	184.92	515.36	134.02
12	Illinois.....	15,000.00	7,298.19	3,381.89	1,356.96	449.06	150.00	120.00	231.60
13	Indiana.....	15,000.00	8,675.44	2,207.30	1,546.02	485.35	86.81	60.27	96.55
14	Iowa.....	15,000.00	9,841.62	.....	2,118.74	144.25	277.94	.....	780.08
15	Kansas.....	15,000.00	7,203.50	4,441.68	507.43	288.00	273.62	.....	28.00
16	Kentucky.....	15,000.00	10,077.10	935.59	288.65	416.70	187.33	586.87	440.82
17	Louisiana.....	15,000.00	14,296.32	20.00	683.68	.....	.....	.....	.....
18	Maine.....	15,000.00	7,589.43	785.84	332.83	433.44	283.66	175.95	251.79
19	Maryland.....	15,000.00	7,774.95	2,386.40	976.24	326.09	194.83	475.71	21.95
20	Massachusetts.....	15,000.00	4,568.74	4,202.04	1,858.60	591.39	329.50	239.16	122.85
21	Michigan.....	15,000.00	6,158.03	5,435.15	250.16	471.32	241.48	39.31	148.08
22	Minnesota.....	15,000.00	8,020.70	.....	633.49	384.70	.....	1,496.37	56.86
23	Mississippi.....	15,000.00	7,201.02	2,216.60	665.95	435.90	399.92	56.52	.....
24	Missouri.....	15,000.00	6,423.14	2,451.68	724.44	574.10	61.35	78.11	35.42
25	Montana.....	15,000.00	9,447.26	1,598.66	1,137.71	409.98	427.43	580.20	175.66
26	Nebraska.....	15,000.00	9,431.04	1,316.54	2,232.14	374.69	52.08	.....	71.38
27	Nevada.....	15,000.00	5,514.32	3,431.48	803.90	229.63	329.35	267.10	261.09
28	New Hampshire.....	15,000.00	7,907.63	2,641.24	1,195.87	152.32	189.59	222.25	124.08
29	New Jersey.....	15,000.00	8,250.00	838.07	1,040.89	1,101.54	176.07	419.99	255.70
30	New Mexico.....	15,000.00	5,382.03	1,758.24	1,573.61	222.80	547.50	489.47	31.17
31	New York (State).....	1,500.00	1,500.00	.....	.....	.....	.....	.....	.....
32	New York (Cornell).....	13,500.00	8,091.59	1,402.73	1,382.57	292.53	15.80	128.65	32.10
33	North Carolina.....	15,000.00	7,708.65	1,650.86	1,047.44	449.09	59.47	136.86	.....
34	North Dakota.....	15,000.00	8,248.04	2,560.04	2,016.02	150.07	9.50	366.76	56.27
35	Ohio.....	15,000.00	14,490.00	207.07	.....	3.09	.....	.....	.....
36	Oklahoma.....	15,000.00	6,114.55	3,739.08	1,064.81	431.77	234.55	176.40	293.33
37	Oregon.....	15,000.00	9,792.97	2,619.96	608.48	74.65	80.14	.....	122.10
38	Pennsylvania.....	15,000.00	9,014.72	1,557.34	1,125.83	571.88	.....	352.71	1,416.22
39	Rhode Island.....	15,000.00	8,484.77	2,493.73	47.99	226.62	113.05	486.23	10.31
40	South Carolina.....	15,000.00	10,146.19	1,274.86	1,137.40	108.67	109.87	3.08	432.73
41	South Dakota.....	15,000.00	7,379.00	2,540.40	1,587.55	227.93	237.32	.....	432.64
42	Tennessee.....	15,000.00	8,500.00	3,076.31	684.16	296.60	154.19	293.31	212.04
43	Texas.....	15,000.00	5,826.34	2,496.62	2,428.94	608.27	196.24	89.96	158.12
44	Utah.....	15,000.00	4,862.73	3,681.15	703.76	381.92	42.85	91.94	89.95
45	Vermont.....	15,000.00	7,038.73	2,822.55	646.31	543.63	159.05	315.81	257.27
46	Virginia.....	15,000.00	8,623.22	1,354.36	2,272.56	399.94	232.93	167.61	294.58
47	Washington.....	15,000.00	9,513.10	2,518.83	618.87	120.18	28.47	1,830.31	.....
48	West Virginia.....	15,000.00	8,890.96	.....	53.86	380.88	417.36	1,128.59	62.97
49	Wisconsin.....	15,000.00	8,245.00	1,526.05	17.50	209.00	111.86	116.36	594.70
50	Wyoming.....	15,000.00	7,439.72	1,708.00	904.93	267.80	223.35	500.00	119.77
Total.....		720,000.00	390,939.94	100,917.84	48,155.87	16,784.08	9,777.64	13,467.24	9,347.95

a Balance, \$2.00.

b Balance, \$323.90.

c Balance, 26 cents.

for the agricultural experiment stations for year ended June 30, 1907.

Classified expenditures.										
Seeds, plants, and sundry supplies.	Fertilizers.	Feeding stuffs.	Li-brary.	Tools, imple-ments, and ma-chinery.	Furni-ture and fix-tures.	Scien-tific appa-ratus.	Live stock.	Travel-ing ex-penses.	Contin-gent ex-penses.	Build-ings and re-pairs.
\$1,020.44	\$449.94		\$455.97	\$137.73	\$147.31	\$233.18	\$5.00	\$23.79	\$50.91	\$511.26
302.83	208.62	\$289.12	6.00	695.25	537.66	116.77	313.50	476.80		477.93
700.89	9.50	77.24	158.93	120.45	133.64		595.00	420.72	15.00	703.82
178.63	7.98	86.79	104.97	54.15	243.10	241.70	15.00	437.48	22.60	191.55
203.12		11.10	1.80	19.50	90.29	131.59		704.93	21.00	446.60
333.99	23.13	401.37	83.46	102.14	102.96	14.38	15.00	326.67	15.00	48.79
387.58	410.15	199.54	321.69	113.10	168.95	17.02	617.50	1,141.52	166.21	183.65
305.70	687.09	1,236.90	327.06	223.81	44.20	20.00		1,028.28	15.00	750.00
342.24	513.39	1,193.85	7.28	145.81		4.50	61.50	71.80	15.00	705.58
759.92	76.43	215.12	30.07	73.44	88.12	1.07	341.05	674.18	15.00	456.92
385.80	17.59	102.00	95.65	435.04	180.09	63.82	300.00	382.61	32.95	16.84
463.28			214.68	158.59	47.20	166.50		548.66		243.35
351.18				40.88		220.31	1,210.00		15.00	
1,063.89		8.00	33.23	161.03	23.21	42.87	503.80	312.60	15.00	94.14
310.20			519.45	124.68	667.10	24.05		259.67	15.00	146.79
310.91	85	1,296.83	965.71	73.06	850.45	310.67	173.40	400.18	15.00	750.00
418.96	262.50	349.55	289.49	516.04	107.95		462.50	229.51	31.58	175.75
542.51	107.85	405.50	134.82	259.80	371.55	210.04	36.50	648.73	28.09	252.32
649.77	73.96	194.36	167.05	113.95	141.49	206.33		322.84		62.82
553.88	36.00	1,779.35		537.15	82.91	261.24	643.25	150.77		358.33
966.68	3.75	833.54	25.25	355.58	251.90		575.00	247.47	15.00	749.92
1,282.63	4.00	2,345.70	145.17	107.42	25.75	31.69		534.96	15.00	159.44
	40.00		128.41	465.59	215.44	358.66			15.00	
329.04		404.15		62.80	183.06	310.28		217.80	15.00	
607.42	37.50	405.86	113.07	772.47	194.58	26.25	906.25	339.19	15.00	745.54
591.78	231.02	20.17	229.06	434.00	56.17	213.09	206.17	453.22	19.16	116.18
247.20	246.40	232.20	579.97		246.39	273.59		335.55	15.00	741.44
1,438.44	134.00	1,674.01		312.13	214.60	8.66	337.00	841.35	35.00	
142.88		189.40	19.40		816.31	107.91		174.43	30.30	673.40
592.10	224.88	362.34	9.50	481.76	619.36		655.00	290.34	15.00	697.35
305.00		185.90	12.70	20.38	181.10	109.63	500.00	251.09	15.00	12.50
					139.50			145.34	15.00	
558.92		498.63	61.96	294.92	232.76	315.03	257.76	43.42	15.00	667.11
365.09		260.11	237.98	420.77				287.90	32.00	97.85
188.87		26.71	175.68	62.55	3.25	255.41	10.20	202.61	27.47	8.29
375.85	157.43	709.34	43.29	177.49	527.22	21.42	2.00	399.99	15.00	708.27
360.33	59.85	185.06	84.34	322.60		140.65	424.40	131.31	63.41	15.25
647.28		581.26		114.90	45.00	123.15	450.00	243.87	15.00	374.70
161.81	149.21	139.52	242.98	58.50	430.60	6.95		270.91	15.00	308.01
525.33	24.85	332.85	60.80	106.87	205.59	463.05	86.00	752.90	15.00	622.27
470.71	72.95	1,611.58	38.54	530.88	575.01	36.94	1,131.25	317.00	15.00	345.84
155.36	307.84	289.47	200.45	22.22	389.57	645.23		436.16	24.05	746.30
410.00			49.84	22.16	478.88	57.38	190.00	182.80	35.00	228.74
50.95		59.84						269.45		
165.59		1,329.26	495.40	388.02	12.80	284.71		593.95	107.50	688.15
583.68		555.16	553.25	295.83	637.60	605.09	58.00	289.95	15.00	595.97
458.14		1,547.13	30.00	390.49	30.00	36.72	422.22	261.50	41.25	618.98
21,571.60	4,578.66	22,716.01	7,454.35	10,325.93	10,740.53	6,717.42	11,504.25	17,066.20	1,140.39	16,467.94

TABLE 11.—Expenditures from United States appropriation of March 16, 1906,

Station.	Amount of appropriation.	Classified expenditures.						
		Salaries.	Labor.	Postage and stationery.	Freight and express.	Heat, light, and water.	Chemical supplies.	Seeds, plants, and sundry supplies.
1 Alabama.....	\$7,000.00	\$4,500.04	\$209.41	\$47.40	\$72.36	\$14.30	\$124.96	\$319.34
2 Arizona.....	7,000.00	6,163.71	164.75		97.99	2.60	35.63	64.91
3 Arkansas.....	7,000.00	3,577.03	814.54		23.50		214.50	228.27
4 California.....	7,000.00	2,949.06			76.65		537.69	260.28
5 Colorado.....	7,000.00	4,614.81	701.55		93.07		38.05	23.15
6 Connecticut (State).....	3,500.00	1,700.00	1,136.50		38.74		15.83	200.33
7 Connecticut (Storrs).....	3,500.00	2,214.51	183.23				379.52	236.59
8 Delaware.....	7,000.00	4,904.87	512.83		1.65	151.29	430.47	233.32
9 Florida.....	7,000.00	4,487.47	14.00		3.25		644.81	74.67
10 Georgia.....	7,000.00	5,345.00	273.35		66.51	82.13		471.66
11 Idaho.....	7,000.00	1,938.89	946.53		15.50		112.65	551.76
12 Illinois.....	7,000.00	3,526.62	475.93	175.88	68.80		942.82	426.24
13 Indiana.....	7,000.00	2,938.19	38.75		38		1,286.24	203.33
14 Iowa.....	7,000.00	3,368.33	425.16	38.32	41.55			373.06
15 Kansas.....	7,000.00	3,649.88	1,253.81	46.03	75.68	28.60	436.55	257.36
16 Kentucky.....	7,000.00	4,908.32	6.15				458.99	
17 Louisiana.....	7,000.00	5,300.17	36.50	1.70	41.81	282.36	203.74	25.90
18 Maine.....	7,000.00	5,654.52	1.50		2.10	28.82	3.17	261.74
19 Maryland.....	7,000.00	3,871.96	849.25	16.78			318.60	73.86
20 Massachusetts.....	7,000.00	4,731.74	899.32		31.77		152.99	163.02
21 Michigan.....	7,000.00	1,766.40	1,402.10	4.77	64.35		20.79	1,868.40
22 Minnesota.....	7,000.00	3,460.57	2,192.32	1.90	28.78	182.94	77.71	15.98
23 Mississippi.....	7,000.00	326.63	40.00	3.00	525.24		78.21	166.00
24 Missouri.....	7,000.00	270.00	1,727.57		300.00		231.79	662.35
25 Montana.....	7,000.00	4,015.03	686.44	16.30	124.98	9.55	25.55	170.23
26 Nebraska.....	7,000.00	5,307.82	102.63	78.90	154.49		238.73	194.72
27 Nevada.....	7,000.00	5,675.83	7.20	49.38	120.03		280.02	135.05
28 New Hampshire.....	7,000.00	4,556.60	589.19		131.44		16.44	385.89
29 New Jersey.....	7,000.00	5,410.00	302.03					63.62
30 New Mexico.....	7,000.00	2,385.24	1,420.69	2.45	75.60		82.83	29.95
31 New York (State).....	700.00	587.05		.45			112.50	
32 New York (Cornell).....	6,300.00	2,958.32	217.28	141.61	35.24	2.40	143.15	1,109.38
33 North Carolina.....	7,000.00	4,433.33	522.98	57.81	88.25	48.88	97.59	163.09
34 North Dakota.....	7,000.00	3,646.60	1,643.10	54.37	103.34		16.10	158.23
35 Ohio.....	7,000.00	5,749.61	155.00		5.42		230.59	138.90
36 Oklahoma.....	7,000.00	1,875.55	864.64	3.50	24.70		2.90	91.43
37 Oregon.....	7,000.00	2,464.18	1,097.90	1.45			306.09	583.07
38 Pennsylvania.....	7,000.00	3,385.58	82.33	4.25			1,431.14	59.08
39 Rhode Island.....	7,000.00	4,686.03	720.00	.88	1.34	45.50	39.82	118.45
40 South Carolina.....	7,000.00	2,400.00	817.28	14.55	67.50		12.77	118.93
41 South Dakota.....	7,000.00	1,986.00	3,153.50	34.69	183.69		355.38	170.08
42 Tennessee.....	7,000.00	4,203.34	262.71	39.89	175.26	48.80	127.11	91.41
43 Texas.....	7,000.00	1,869.50	722.38	26.25	278.25	54.78	810.66	324.02
44 Utah.....	7,000.00	2,408.08	1,285.69	35.15	35.81	148.87	255.71	94.34
45 Vermont.....	7,000.00	2,911.13	928.74	28.39	57.77	153.94	28.24	192.24
46 Virginia.....	7,000.00	2,240.04	202.60		178.97		327.53	927.54
47 Washington.....	7,000.00	5,937.55	175.70		19.97		2.50	229.32
48 West Virginia.....	7,000.00	4,553.33		.50		5.50		6.74
49 Wisconsin.....	7,000.00	4,065.00	839.00			112.00	214.85	78.87
50 Wyoming.....	7,000.00	2,398.00	1,007.97		386.92	10.79	389.38	49.35
Total.....	336,000.00	178,307.46	32,112.03	1,245.80	4,393.52	1,414.05	12,243.29	12,835.45

for the agricultural experiment stations for year ended June 30, 1907.

Classified expenditures										
Fertilizers.	Feeding stuffs.	Library.	Tools, implements, and machinery.	Furniture and fixtures.	Scientific apparatus.	Live stock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	Balance.
\$6.25	\$61.14	\$49.18	\$92.85	\$42.50	\$929.07	\$124.00	\$407.20			1
		13.04	268.40		161.37		27.60			2
	814.92	138.52		116.50	476.70	192.43	63.64		\$307.61	3
18.90			109.68	83.65	1,042.22	457.50	1,419.42	\$4.00		4
		411.48		28.45	228.34		508.75			5
111.07			101.20	12.50			183.83			6
		43.89	30.61	62.40	347.00		2.25			7
	25.19	7.50	14.15	167.50	206.51	69.75	217.62	18.60		8
178.92		360.18	178.72		604.52		331.17			9
	285.79	58.96	58.21				27.46		293.43	10
		694.04	1,895.80		16.40		83.35	10.00	326.23	11
			3.13	800.25	266.34		142.37	34.50	1.50	12
	5.00	502.58	47.40		1,468.14	234.50	251.00		17.80	13
59.91	107.32		185.58	32.50		1,945.30	422.97			14
	24.56	4.10	375.83	125.72		2.25			350.00	15
		19.22	218.00	260.00	1,129.32					16
				40	476.96		123.35		308.50	17
51.34	8.65	151.74		30	471.36	37.92	199.74			18
	4.60	320.41	70		966.93		87.74		350.00	19
	362.00	26.77	54.11	12.00	439.92		80.57	2.00	75.00	20
96.48	176.55	141.94	8.70		445.15	164.40	450.62			21
32.68	155.26	275.08			9.50		79.97		256.36	22
	223.25	4.25	387.05	35.25		5,284.27	295.70			23
	670.85		18.20		2,332.91	455.00	9.53		350.00	24
		172.89	37.00	137.25	961.28		305.90		337.55	25
134.84	163.75		35.80	45.00	303.96		239.36			26
	8.00	53.93		173.76	242.56	40.50	213.74			27
	146.93		14.90		615.26	105.00	93.22		345.13	28
		308.83	116.94		798.58					29
	1,195.28		993.75	77.50		336.71	50.00		350.00	30
										31
		101.71	117.54	312.90	845.47				315.00	32
125.94	72.21	303.62	190.50		747.26		148.54			33
1.50		4.00	117.90	167.40	787.46				300.00	34
				400.00	244.02		76.46			35
	1,002.30		35.10	224.12	274.87	2,062.00	188.89		350.00	36
		114.18	201.06	148.70	1,386.60		346.77		350.00	37
693.52		280.14	11.20	11.05	848.59		177.53	15.59		38
60.82	288.41	507.09	17.70		178.05	181.50	154.41			39
157.23	1,141.84		174.59		294.04	1,741.85	59.42			40
	60.80		101.75		599.11		5.00		350.00	41
		409.45	9.00	259.28	1,211.77		161.98			42
94.70	357.91	287.62	48.90	81.50	234.35	1,065.00	419.85		324.33	43
	478.75	41.87	430.78	525.84	583.83	152.91	231.45		290.92	44
	1,353.48		186.68		161.80	537.50	110.09		350.00	45
	4.20	430.96	3.50	144.59	2,263.52	10.00	207.90		58.65	46
			24.60		83.50		476.86		50.00	47
	5.10				2,428.83					48
	623.37		331.19		406.90	235.00	63.82			49
			1,688.16		117.88		596.70	4.85	350.00	50
1,824.10	9,827.41	6,239.17	8,937.26	4,488.41	29,007.78	15,435.29	9,753.74	88.94	6,758.01	1,088.29

TABLE 12.—*Disbursements from the United States Treasury to the States and Territories for agricultural experiment stations under the acts of Congress approved March 2, 1887, and March 16, 1906.<sup>a</sup>*

State or Territory.	Hatch Act.		Adams Act.	
	1888-1906.	1907.	1906.	1907.
Alabama.....	\$284,999.34	\$15,000.00	\$5,000.00	\$4,019.89
Arizona.....	249,803.15	15,000.00	5,000.00	7,000.00
Arkansas.....	283,163.12	15,000.00	5,000.00	7,000.00
California.....	285,000.00	15,000.00	5,000.00	6,926.84
Colorado.....	284,963.24	15,000.00	5,000.00	7,000.00
Connecticut.....	285,000.00	15,000.00	5,000.00	7,000.00
Dakota (Territory).....	56,250.00			
Delaware.....	284,438.84	14,944.03	5,000.00	4,050.34
Florida.....	284,966.11	15,000.00	5,000.00	6,998.11
Georgia.....	285,983.55	15,000.00	5,000.00	7,000.00
Idaho.....	210,000.00	15,000.00	5,000.00	5,182.04
Illinois.....	285,000.00	15,000.00	5,000.00	7,000.00
Indiana.....	284,901.19	15,000.00	5,000.00	2,000.00
Iowa.....	285,000.00	15,000.00	5,000.00	7,000.00
Kansas.....	285,000.00	15,000.00	5,000.00	7,000.00
Kentucky.....	284,996.57	15,000.00	5,000.00	7,000.00
Louisiana.....	285,000.00	15,000.00	5,000.00	7,000.00
Maine.....	284,999.62	15,000.00	5,000.00	7,000.00
Maryland.....	284,967.40	15,000.00	5,000.00	6,763.99
Massachusetts.....	284,617.70	15,000.00	5,000.00	7,000.00
Michigan.....	285,000.00	15,000.00	5,000.00	3,691.60
Minnesota.....	285,000.00	15,000.00	5,000.00	7,000.00
Mississippi.....	285,000.00	15,000.00	5,000.00	7,000.00
Missouri.....	280,007.24	15,000.00	5,000.00	7,000.00
Montana.....	195,000.00	15,000.00	5,000.00	4,417.13
Nebraska.....	284,932.16	15,000.00	5,000.00	7,000.00
Nevada.....	284,939.32	15,000.00	5,000.00	6,772.94
New Hampshire.....	285,000.00	15,000.00	5,000.00	7,000.00
New Jersey.....	284,961.97	15,000.00	5,000.00	7,000.00
New Mexico.....	249,998.90	15,000.00	5,000.00	7,000.00
New York.....	284,945.27	14,915.27	5,000.00	6,880.85
North Carolina.....	285,000.00	15,000.00	5,000.00	7,000.00
North Dakota.....	242,330.62	15,000.00	5,000.00	7,000.00
Ohio.....	285,000.00	15,000.00	5,000.00	5,514.02
Oklahoma.....	224,270.80	15,000.00	5,000.00	2,000.00
Oregon.....	271,631.82	15,000.00	5,000.00	2,000.00
Pennsylvania.....	284,967.95	15,000.00	5,000.00	6,995.41
Rhode Island.....	285,000.00	15,000.00	5,000.00	4,464.20
South Carolina.....	284,542.15	15,000.00	5,000.00	5,560.12
South Dakota.....	228,250.00	15,000.00	5,000.00	2,000.00
Tennessee.....	285,000.00	15,000.00	5,000.00	7,000.00
Texas.....	285,000.00	15,000.00	5,000.00	4,876.91
Utah.....	250,000.00	15,000.00	5,000.00	6,821.94
Vermont.....	285,000.00	15,000.00	5,000.00	7,000.00
Virginia.....	284,992.57	15,000.00	5,000.00	6,997.95
Washington.....	225,000.00	15,000.00	5,000.00	3,080.11
West Virginia.....	284,969.22	14,999.49	5,000.00	4,859.12
Wisconsin.....	285,000.00	15,000.00	5,000.00	7,000.00
Wyoming.....	270,000.00	15,000.00	5,000.00	7,000.00
Total.....	13,208,879.82	719,858.79	240,000.00	287,873.51

<sup>a</sup> The figures in this table were furnished by the Treasury for the use of this Department by the courtesy of the honorable Secretary of the Treasury.

## PROGRESS IN AGRICULTURAL EDUCATION, 1907.

By DICK J. CROSBY.

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### INTRODUCTION.

The recognition of agriculture as a teachable subject having educational value is no longer confined to the institutions and men whose main work is along agricultural lines. It is now rated with other scientific and technical subjects as a suitable major for the doctorate in philosophy, not only in such large universities as Cornell and Wisconsin, where agriculture is regularly taught in undergraduate courses, but also in such institutions as Clark University and Columbia University. Clark University has recently conferred the degree doctor of philosophy for a thesis on Agricultural Education, which has since been published as a bulletin of the Bureau of Education. Columbia University has announced that it will accept work done in agriculture in any of the leading agricultural colleges at full value for degrees, and one of its graduate students is investigating the teaching of agriculture in secondary schools as his major subject for a doctor's degree. The National Education Association, through its committee on industrial education in schools for rural communities, is continuing its study of agriculture as a public school subject of instruction, and its board of directors has granted permission for the organization of a department of rural and agricultural education. The Massachusetts Commission on Industrial Education is giving much encouragement to the establishment of secondary schools of agriculture in that State. At the first session of the Sixtieth Congress several bills intended to promote agricultural education in the several States and Territories have been introduced, and many of the different State legislatures have recently been called upon to consider similar local legislation.

Some of the more important features of the work of institutions engaged in promoting agricultural education are reviewed in the following pages.



**EDUCATIONAL WORK OF THE DEPARTMENT OF AGRICULTURE.**

With every passing year the work of the United States Department of Agriculture to aid the States in the education of the farmer and his children increases in amount and importance. This work of the Department is now generally recognized to be one of its legitimate and essential functions, and an effective means of bringing to the attention of the farming people the results of its own investigations and those of the experiment stations. The President of the United States in his first message to the Sixtieth Congress said:

The National Government, through the Department of Agriculture, should do all it can by joining with the State governments and with independent associations of farmers to encourage the growth in the open farming country of such institutional and social movements as will meet the demand of the best type of farmers, both for the improvement of their farms and for the betterment of the life itself. The Department of Agriculture has in many places, perhaps especially in certain districts of the South, accomplished an extraordinary amount by cooperating with and teaching the farmers through their associations, on their own soil, how to increase their income by managing their farms better than they were hitherto managed. The farmer must not lose his independence, his initiative, his rugged self-reliance, yet he must learn to work in the heartiest cooperation with his fellows, exactly as the business man has learned to work; and he must prepare to use to constantly better advantage the knowledge that can be obtained from agricultural colleges, while he must insist upon a practical curriculum in the schools in which his children are taught.

Concerning instruction in meteorology, the Chief of the Weather Bureau reports as follows:

A steady increase of interest in meteorological education is manifest throughout the country, as, in fact, throughout other civilized nations. In general, instruction in meteorology is considered as a part of the courses in geology, geography, or physical geography; but in two universities, George Washington and Cornell, courses have been offered in the higher mathematics and physics that constitute the fundamental basis of meteorology.

During 1907 there were fourteen universities, colleges, and scientific schools in which regular courses of instruction were given by Weather Bureau officials, and in five or six more the matter was in abeyance. Also there were at least forty officials besides those conducting the above-mentioned courses who gave occasional lectures or addresses.

The Chief of the Bureau of Plant Industry reports on the distribution of seeds for school gardens as follows:

The school-garden work which has heretofore been conducted by the office of the Horticulturist has been considerably enlarged during the present year. The work of supplying flower and vegetable seed to teachers of the rural schools was extended to every State in the Union save two, namely, Arkansas and Nevada. The four States which received the greatest number were New York, Illinois, Maryland, and Massachusetts in the order named. The extent of this work can be seen when it is stated that the number of individual gardens which, if planned on the basis suggested in *Farmers' Bulletin* No. 218, could be main-

tained with the seed furnished aggregates 36,173 flower gardens and 31,480 vegetable gardens. In addition to the seed, 5,102 decorative collections, consisting of ten varieties of annual flowering plants, have been distributed to these schools. The total number of packets of flower and vegetable seed sent out for school purposes was 388,285. It is evident from these figures that there is a very general interest in the school-garden work, and as the demand increases each year it is believed that a very important educational want is being met.

The Forest Service has sent thousands of its publications to teachers and school officers and has recently published a valuable circular on Forestry in the Public Schools. The Service is now cooperating with the Office of Experiment Stations in preparing exercises in forestry for elementary and secondary schools.

The results of the investigations conducted by the Department are made known and become available for the use of the people mainly by means of publications, of which 1,415 were issued during the year, 596 being new and 819 reprints. These publications comprised 52,363 printed pages and the total number of copies aggregated 16,746,910, an increase of 3,258,889 copies over last year. The Department publications are used more and more in educational institutions—colleges, high schools, and primary schools—for reference purposes and to supplement the text-books in geography and agriculture.

#### **EDUCATIONAL WORK OF THE OFFICE OF EXPERIMENT STATIONS.**

The educational work of the Office of Experiment Stations for 1906-7 was carried on under the same general arrangement as in the preceding year, one section dealing with agricultural colleges and schools and the other with farmers' institutes and other forms of extension work in agriculture. While there was no increase in the funds available for this work, improvements in the service were made possible through a better understanding of the needs of agricultural educational institutions and a little clearer differentiation of the educational work from the other work of the Office.

The work relating to agricultural colleges and schools has been continued under four general classes: (1) The collection and publication of information regarding the progress of agricultural education at home and abroad; (2) studies of different grades of American and foreign schools in which agriculture is taught; (3) work in cooperation with the Association of American Agricultural Colleges and Experiment Stations and other important associations dealing with educational matters; and (4) the giving of aid to agricultural colleges and schools and to State and local school authorities along lines of agricultural education.

**RELATION TO AMERICAN INSTITUTIONS.**

The department of agricultural education in the Experiment Station Record has contained quite a large number of brief abstracts and notes relating to this subject. The preparation of these involved the examination regularly of many educational journals and other publications, both American and foreign. The foreign publications, more than 1,000 in number, were reviewed by Miss M. T. Spethmann, who has also, as formerly, had charge of the preparation of the annual statistics and organization lists of the agricultural colleges and experiment stations. There have also been prepared and published a list of institutions in the United States giving instruction in agriculture, a circular on A Secondary Course in Agronomy, a Yearbook article on Introduction of Elementary Agriculture Into Schools, a bulletin on Exercises in Elementary Agriculture, and a review of progress in agricultural education in 1906. The latter deals with agricultural education throughout the world, and includes, among other features, a suggestive course in nature study and elementary agriculture for the schools of California, the course of study for the Cecil County (Md.) Agricultural High School, and a detailed course in agriculture for the eleven industrial and agricultural schools in Georgia. A bulletin of elementary exercises intended to show the relations of chemistry to agriculture has been published. Elementary and secondary exercises in forestry are being prepared.

Studies of American and foreign schools in which agriculture is taught have been carried on in connection with editorial work, and the number of cards in the index to these institutions has been increased by 330, making a total of 3,630. There have also been prepared during the year 1,200 cards of foreign agricultural research institutions. In connection with the annual inspection of agricultural experiment stations and on occasions when members of the staff have been called upon to attend important meetings, quite a large number of American colleges and schools of agriculture have been visited. The educational work in cooperation with the Association of American Agricultural Colleges and Experiment Stations has been continued upon the same basis as formerly. The Director of this Office has continued to act as bibliographer of the association and as chairman of its committee on instruction in agriculture. He will again act as dean of the Graduate School of Agriculture.

The giving of aid to agricultural colleges and schools and to State and local school authorities along agricultural lines continues to be the most rapidly developing feature of our educational work. This is true even with reference to the older well-established colleges and schools. Agricultural education is of such recent development in this country that courses of study and faculties are constantly under-

going readjustment. As a result the authorities in control make frequent demands upon this Office for advice and assistance concerning courses of study, new buildings, equipment, instructors, and other similar matters. On the one subject of home economics the Office was called upon to make three rather lengthy compilations during the year. One of these related to the schools of cooking and domestic art in Great Britain, another to the introduction of domestic science courses in the land-grant colleges of this country, and another to domestic science schools in the United States. Much of the correspondence of the Office is of this nature, calling for information which can be furnished only after considerable study or the examination of numerous publications. During the year more than 2,600 letters were written on the general subject of agricultural colleges and schools.

Information is frequently sought concerning available candidates for positions in agricultural colleges and schools. This information the Office is now able to supply in part through its card directory of teachers and investigators in agriculture, which is now supplemented by a special list of those seeking positions. These lists contain about 1,400 cards and are revised annually by Miss M. A. Agnew.

Consistent with the policy of the Office for a number of years back, have been its efforts to keep pace with the growing demands upon it for advice and assistance in outlining courses of study, securing teachers, and determining the policy of secondary and elementary schools in which agriculture is being introduced.

The course of study prepared by the writer for the agricultural high schools in Georgia was adopted at a meeting of representatives from the different local boards of trustees held in Atlanta May 23, 1907. The small agricultural high school which was started at Calvert, Md., in the fall of 1906 with Mr. H. O. Sampson, of this Office, in charge as principal, was conducted so successfully in temporary quarters with very inadequate facilities as to result in an appropriation of \$5,000 from the county for the purchase of land and the erection of a suitable building for the school.

There is a growing demand for instruction in agriculture at teachers' institutes and summer schools for teachers. Largely as a result of the work of Mr. Sampson in the summer of 1906 in the teachers' institutes of Wisconsin, Pennsylvania, and Maryland the Office received fifty-one requests for similar aid in 1907. Mr. Sampson returned to the Office in June and as soon as the institute season opened he was sent out on this work, which occupied nearly his whole time up to September 1, at which time he returned to his school in Maryland. All through the year there have been numerous requests for addresses on various phases of agricultural education. The Director has spoken at State teachers' associations, conventions of farmers and school officers, college commencements, and other important meet-

ings; the expert in agricultural education has taken part in about a dozen such meetings, and other members of the Office have given occasional addresses.

### RELATION TO FOREIGN INSTITUTIONS.

#### INTERNATIONAL CONGRESS OF AGRICULTURE, AT VIENNA.

The Eighth International Congress of Agriculture was held at Vienna May 21-26, with over 2,000 delegates and visitors in attendance. The congress was opened by Prince Carl Auersperg. Senator and ex-Minister of Agriculture Jules Meline, of France, delivered the opening address on The Return to Mother Earth, in which he made a strong plea for agriculture and rural life, in both its economic and social phases. In his opinion a very marked tendency is now manifested in most countries to give to the tillers of the soil a higher social position. An indication of this was evidenced in the placing of the palatial Parliament building at the disposal of the congress for its meetings, a privilege never before accorded to representatives of agriculture. For the transaction of business the congress was organized into eleven sections, among which were those on rural economics, agricultural education, farm machinery, crops and plant industry, brewing, and irrigation and drainage.

Papers on the organization and function of the experiment stations were submitted by Dr. F. W. Dafert, of Vienna; Dr. Thomas Kosutany, director of the Hungarian experiment station at Budapest, and Dr. A. C. True, of this Office. In these papers the chief function of the stations was declared to be investigation in agriculture, and the necessity of relieving the chief officers of essentially all work of instruction and of control work involved in the execution of the laws relating to agriculture was emphasized. Resolutions embodying these conclusions were adopted by the section. As in previous years, special attention was given by the congress to a discussion of farm mechanics. The desirability and importance of establishing international rules for the testing of farm machines were pointed out, although it was admitted that in the testing of tools used for the cultivation of the soil the soil conditions made the establishment of definite conditions for such tests practically impossible. Attention was called to the importance of instruction in the use of farm machines in agricultural schools, including practical work in the construction and repair of implements and actual field tests.

During the congress trips were made to the local experiment station, the agricultural high school, and other points of interest. The utmost hospitality was shown by the citizens and officials of Vienna, receptions being tendered by the mayor, Emperor Francis Joseph, and others.

## AUSTRALIA AND NEW ZEALAND.

The Queensland Agricultural College has been giving training courses in agriculture for teachers in State schools, and as a result some instruction in agriculture has been given in a number of schools. A movement has also been started to offer prizes for school gardens in the different districts of Queensland, and the Queensland department of agriculture has agreed to instruct its experts to visit country schools, as far as practicable, and give the pupils and teachers guidance and help.

In Victoria farmers' classes were organized by the department of agriculture in 1902 and held in 3 centers. In 1906 they were held in 18 centers with an attendance of 1,320 persons, and in 1907 in 26 centers. Attached to the viticultural station, at Rutherglen, is an area of 800 acres which it has been decided to work as a general farm, and at the same time to utilize the buildings originally intended for a college as an educational center for the orphans from the neglected children's department. Twenty-two boys are now being trained in farm and vineyard work, and preparations are complete for receiving 15 more boys. One hundred acres are cultivated, and there are 300 sheep and 70 cattle, chiefly dairy cows, on the farm. The agricultural high schools which have been recently opened at Warrnambool and Sale are receiving good support, and active steps are being taken to establish four others. The conditions for the establishment of these schools provide that half the cost of the buildings shall be obtained locally, together with 20 acres of land, and that an attendance of at least 50 pupils shall be guaranteed at a fee of about \$40 a year each.

In New Zealand the Canterbury Agricultural College, at Lincoln, now has an endowment of 62,000 acres of land, which has a rental value of \$7,290, and possesses extensive buildings and an experimental farm. The institution offers a good course in the science and practice of agriculture, which is accepted as a part of the curriculum leading to the degree of B. S. in agriculture at the University of New Zealand. The college accommodates 40 students. A report on the public schools for 1904 shows that 47 out of 725 schools gave instruction in elementary agriculture.

## AUSTRIA.

The Wiener Landwirtschaftliche Zeitung is authority for the statement that in 1906-7 there were 195 institutions in Austria giving instruction in agriculture and forestry.

These include 6 institutions established within the year, namely, the agricultural division of the Royal Imperial Technical High School at Prague, the Royal Imperial Agricultural Educational and

Experimental Institute at Spalato, the farm school at Mikozin, agricultural winter schools at Judenburg and Friesach, and the domestic science school at Chrudin.

The schools making up the total include the following: Three high schools; 3 higher agricultural institutes or academies; 9 agricultural secondary schools; 5 higher forestry institutes; 2 higher institutes for viticulture, pomology, and horticulture; 1 higher institute for the brewing industry; 43 lower agricultural schools; 75 agricultural winter schools; 16 lower forestry schools; 17 dairy and domestic science schools; 23 lower special schools for gardening, pomology, viticulture, and hop, alpine, and bee culture; 2 brewing schools, and 2 distillery schools.

A recent number of the *Deutsche Landwirtschaftliche Presse* states that an agricultural department, offering a four-year course, has been established at the Royal Imperial Bohemian Technical High School at Prague. Prof. Julius Stoklasa has been elected dean of the department of agriculture, as well as of the department of "culture-technic." The studies to be taken up this year are higher mathematics, physics and mechanics, organic and inorganic chemistry, anatomy and physiology of plants, economic botany, general and economic zoology, mineralogy and geology, agricultural bacteriology, general biology, and rural economics, including practicums in the chemical and plant laboratories.

#### BRITISH ISLANDS.

The County Councils Association, at its meeting March 27, 1907, adopted a report of its rural education subcommittee dealing with the manner in which education in rural or agricultural subjects can best be fostered in the public elementary schools and evening schools in rural districts.

The report deals first with the nature of instruction in reading, writing, composition, arithmetic, nature study, drawing, and manual work, and maintains that all of these subjects should be taught with the idea of giving local application to the instruction. Reading, for example, should include considerable historical and geographical material of local interest. The composition should deal with nature-study work and manual training. Arithmetic should include the measurement of land, crops, stacks, cisterns, etc., the weighing of cereals and other crops, and problems in home accounts, marketing, profit and loss in the school garden, cost of cultivation, etc. Drawing should include free-hand and color work with plants, as well as geometrical and scale drawing of fields, garden plats, buildings, boxes, and other objects. For the manual training work it is suggested that gardening be carried on for the purpose of studying the

growth of crops in relation to the soil and to obtain skill in the operations of gardening; that there also be given opportunities for woodwork in making hencoops, garden frames, beehives, and other useful articles, and, where possible, exercises in making baskets, nets, mats, etc. For the girls, needlework, cooking, household management, and elementary hygiene are recommended.

The committee emphasizes the importance of instruction in nature study and rural economy for all children, of school gardens in connection with elementary schools and continuation schools, of facilities for training teachers in rural subjects, of the organization of boys' agricultural clubs, gardening clubs, and junior naturalist societies corresponding to similar societies in this country, of making collections for school museums, and of organizing local fairs or exhibitions for the selection of appropriate material for larger agricultural shows.

J. C. Medd in a recent paper discusses the shortcomings of agricultural education in England, the causes of which are attributed mainly to lack of system and central direction. Agricultural instruction of collegiate grade is said to be fairly well provided for, but the great shortcoming is the "scanty provision of facilities for intermediate agricultural education of a systematic character," such as would "provide for the sons of small farmers from 13 or 14 to 16 or 17 years of age." Schools similar to the higher elementary schools in France and winter schools of agriculture and horticulture similar to those in Holland are recommended. The writer believes that the term "agricultural" should not be applied to instruction in the public schools, owing to the general misunderstanding which arises and the discredit into which the subject consequently falls. He would apply the term "rural science" or "nature study" to this class of teaching. He demands for the country boy as thorough an elementary education as the town boy has, and recommends a differentiation between rural and village schools, not by means of any fundamental change in their respective curricula, but by the different treatment of the subjects and "their orientation toward the immediate and varying surroundings of each school."

According to Nature, the president of the Board of Agriculture and Fisheries has appointed a committee to inquire whether the provisions now made for scientific and technical instruction in agriculture in England and Wales are satisfactory and sufficient, and if not, in what manner they may with advantage be modified or extended. Prof. T. H. Middleton and Prof. W. Somerville are members of the committee. At a special meeting of the Lincolnshire Chamber of Agriculture resolutions were passed urging that a more decided agricultural tone should be given to the teaching in the rural



elementary schools and that a complete and consecutive system of secondary education should be established in the rural districts.

In Scotland, too, agricultural education is coming in for discussion. At the annual conference of the Scottish Chamber of Commerce in Glasgow, October 23, resolutions were adopted favoring the inclusion of agriculture in the curriculum of the day schools, and instructing the directors to take the necessary steps for bringing this about. The Board of Agriculture and Fisheries was requested to consider the appointment of a departmental commission to inquire into the present condition of agricultural education and research in Scotland, the investigation to correspond in scope to that now in progress in England.

According to the annual report of the Board of Agriculture and Fisheries, during the fiscal year 1906 the grants to agricultural education in Great Britain aggregated about \$420,000. The number of students has increased from 23,000 to 34,000 in the last two years. A widening of public interest in the study of agriculture is reported, and it is stated that farmers are coming to rely more and more upon the agricultural institutions for assistance in the solution of their problems. As the result of an inquiry addressed to the several county councils for the purpose of learning what they were doing in the way of providing instruction in agricultural practice, it was found that the subjects in which instruction is given comprise plowing, drilling, mowing, setting out roots, harvesting, setting up sheaves, stacking, thatching (including rope and spar making), hurdle making, basket making, sheep-shearing, milking, hedging and ditching, land draining, pruning, grafting, budding, hop drying, and fruit packing. In the majority of cases instruction was given for at least two hours a day and for six or more days, and the course usually ended with a competition and prizes for skill in the work that had been undertaken.

At Birmingham University a department of economic zoology has been organized under the direction of W. E. Collinge. Mark Lane Express states that this is to be a "consultative department and bureau of information and experimental work," and that it is the first instance in which a university in Great Britain has offered farmers an opportunity for such free information.

The Horticultural College, Swanley, England, has arranged a one-year course in natural history for students who have passed through the ordinary training in gardening and desire additional training in natural-history subjects in order to qualify as teachers of gardening and nature study. The work will be practical, the first two terms of the course to be devoted to general work in botany, zoology, and geology, and the third term to special subjects.

Armstrong Collège is the recipient of a legacy which will eventually amount to \$225,000. A portion of this fund must be used for increased compensation of the instructor in agriculture.

The professorship in agriculture at Cambridge University was established in 1899, in consequence of an offer by the Worshipful Company of Drapers to contribute \$4,000 a year for ten years for its support. This offer has just been renewed for a second period of ten years, and the chair is henceforth to be designated the "Drapers' Professorship of Agriculture." As previously noted, the Drapers' Company has also offered \$25,000 toward buildings and equipment, for which \$100,000 is desired. From other sources \$35,000 has already been pledged. It is also hoped to increase the annual income by \$3,000, as the number of students in agriculture is rapidly increasing and additional aid is required. Efforts to establish a department of forestry are under way and a beginning has been made toward a forestry museum.

The British Government has acquired a 12,000-acre estate known as Inverliver, in Argyllshire, Scotland, for the purpose of converting it into a state forest station. The estate is situated on the shores of Loch Awe, in one of the most sparsely populated districts of the Highlands, and is surrounded by mountains and moorland.

A committee has been appointed to inquire into and report upon the question of the improvement of forestry in Ireland. Among the topics to receive special attention will be the present provisions for state aid to forestry, the means whereby under the present statutes existing woods may be preserved and land suitable for forestry acquired, and the financial and other provisions necessary for a comprehensive scheme of afforestation.

#### • CANADA.

The experiment of introducing agriculture into some of the high schools of Canada is about to be tried. It is proposed to make a grant to each high school that will establish a class in agriculture and agree to appoint a teacher recommended by the department of agriculture. A plat of ground for demonstration or experimental purposes must be provided, the classes specializing according to the agricultural needs and conditions of the districts in which the schools are located. The teachers' time is to be devoted exclusively to agricultural work, but any time not required by their respective schools is to be available for assisting and encouraging agriculture and nature study in rural schools and in sending the department of agriculture information regarding pests, new and interesting developments in connection with farming, etc.

In a recent number of the *Southern Workman*, G. P. Phenix describes the Macdonald Consolidated School at Kingston, New Brunswick, and shows that while before consolidation the enrollment in the 7 districts was 125, after consolidation it rose to 166 in the first term and 175 in the second. The average attendance in the unconsolidated schools was 44 per cent of the enrollment and in the consolidated school 84 per cent. Thus the daily attendance has been trebled and the percentage of attendance doubled. The writer states that—the real secret of the success of this school at Kingston is to be found in the intrinsic worth of the course of study and in the strength of the instruction in the school itself. The difference between the course of study here and in the ordinary country school is sufficiently suggested by the difference in equipment. The orchard, the grafting tools, the pruning knives, the spraying apparatus, the kitchen with all its household implements, the sewing tables, the benches and tools, and the laboratory for indoor work in the winter—all utterly foreign to the ordinary school—here have a definite use.

#### DENMARK.

According to figures recently published by the Danish bureau of statistics, the number of people's high schools in that country has increased from 3 in 1844 to 71 in 1906, while the attendance in these institutions has grown from 36 to 6,282. Of agronomic schools, there were 5 in 1844, while now there are 14, and the attendance has increased from 42 to 1,126.

A chair of agricultural-technological chemistry has been established at the polytechnic high school, Copenhagen, and Dr. Oria Jensen has been appointed to the position. The studies will be devoted principally to the utilization of milk and meat, and will include (1) the production and chemistry of milk, the bacteriology of milk, its uses for food, milk, powder, casein, cream, butter, and cheese, and dairy associations, and (2) the production of meat and bacon, methods of pickling or salting, chemistry of pickling or salting, canned meat products, and the arrangement of slaughterhouses for pigs.

#### FRANCE.

A scheme is under consideration for the organization in France of a system of schools in which the daughters of farmers may receive instruction and training in agriculture and domestic economy. The minister of agriculture appointed Prof. L. Henry, of the National School of Horticulture, to investigate the matter and has recently made public Professor Henry's report. The first part of the report is taken up with a discussion of the necessity for special instruction for farmers' daughters, in which it is pointed out that in this respect France compares very unfavorably with Belgium, Germany, Austria, England, and North America.

A project for the organization of instruction in agriculture and domestic economy for the daughters of farmers is outlined. The establishment of three types of schools is recommended: (1) Complementary and professional agricultural schools, (2) schools of agricultural home economics, and (3) temporary and movable schools of agricultural home economics.

The first type of school corresponds somewhat nearly to the practical schools of agriculture for boys in France, except that the studies are to be of higher grade and less varied. They are to be elementary finishing schools for farmers' daughters, with a regular course of study covering two years and a supplementary elective course of one year. The subjects to be included in the course of study are pedagogy, French, arithmetic, farm accounts, history, geography, and natural and physical sciences, drawing, and hygiene. The natural sciences will include botany, geology, mineralogy, and zoology, but special attention will be given to domestic economy, horticulture, dairying, poultry culture, and animal husbandry. The report outlines in considerable detail the proposed course of study and the organization and equipment of the schools. This type of school is considered the most important and the one to be most generally established.

The proposed schools of agricultural home economics correspond to the farm schools for boys in France. There are already three such schools, two known as dairy schools and one as a school of agricultural home economics and dairying.

The third type of school is the temporary or movable school of agricultural home economics, corresponding somewhat closely to the winter schools of agriculture in Germany. It is suggested that after these three types of schools are established it would be well to inaugurate one or two superior schools of agricultural home economics corresponding to the national schools of agriculture for young men.

After outlining at some length his project for instruction in home economics in France, the writer describes the various schools and other agencies for the education of young women along lines of agriculture and home economics in Belgium, the Grand Duchy of Luxembourg, Alsace-Lorraine, and Switzerland. He also gives a list of schools for young women in Germany not mentioned in his description. The minister of agriculture of France has recently issued a decree establishing the National School of Horticulture and Basketry of Fayl-Billot in the Department of Haute-Marne. The citizens of Fayl-Billot and the syndicate of basket makers in the region have given the necessary land (22 acres) and \$15,440 for the erection of buildings. The Department of Haute-Marne is to give \$200 and the ministry of commerce and labor \$1,351 annually toward running expenses. The faculty will consist of a director and about six other in-

structors, and the course of study will extend over three years. Eugene Leroux has been appointed director of the school. A recent consular report states that through the influence of the Touring Club of France a manual of elementary forestry has been introduced into the primary schools of that country. This club has also published a manual of forests, illustrating the advantages of preserving the forests of the country and containing a constitution and by-laws for tree-planting societies.

According to the Journal of the Society of Arts, two schools in Lyon teach silk culture. One of these (Ecole Supérieur Commerce) receives pupils from foreign countries and teaches them the entire silk business from the raising of the worms to making the designs, weaving the silk, and putting it on the market. The course of study covers two years. The second school (Ecole Municipal de Tissage et de Broderie) is conducted by the city and is intended only for the children of the inhabitants, although foreigners are received on equal terms with the natives.

#### GERMANY.

The Landwirtschaftliche Jahrbucher contains an interesting and instructive statistical report on the organization, faculty, income, courses of study, attendance, etc., of the agricultural institutions of different grades in Prussia. These include (1) agricultural, forestry, and veterinary schools known as academies; (2) secondary agricultural schools (Mittelschulen); (3) elementary agricultural schools (niedere Schulen); (4) special schools, such as schools of pomology, horticulture, fruit growing, meadow culture, dairying, etc.; (5) special courses for adults, and (6) normal schools for the training of teachers of agriculture. A tabular review is also given of the progress and present status of rural continuation schools. Twenty appendixes contain rules and decrees concerning the qualifications of teachers, examinations, the inspection service, and other matters relating to the institutions listed in the report.

Chemiker Zeitung states that the total number of matriculated students in the German universities is 44,942, of whom 985, or about 2 per cent, are enrolled in agricultural science courses. Of these, 573, or 58 per cent, are from foreign countries, although the foreign students constitute but 9 per cent of the total enrollment.

An interesting type of school is that for women at Maidburg, Germany, which affords training in home economics and agricultural subjects intended to prepare women to take charge of farm homes, including the kitchen, garden, poultry, etc. Adjacent to this school is a training school which affords facilities for young women who wish to prepare to teach home economics. A similar school is to be

opened in the spring of 1908 at Scherpingen, in West Prussia. One of the possible developments of schools of this class, it is suggested, will be to make them social and educational centers for the rural communities, with lectures, entertainments, and libraries maintained in connection with the schools for the benefit of all the people in the vicinity.

A State department of apiculture, under the direction of Dr. A. Fleischmann, was established on November 1 in connection with the Zoological Institute of the University of Erlangen. This institution includes a scientific division under the direction of Dr. Enoch Zander, and a practical division under the direction of Karl Hofmann. The *Deutsche Landwirtschaftliche Presse* in its account of this new institution calls attention to the fact that it is the first of its kind in Europe.

The Association of Apiculturists of the Province of Schleswig-Holstein has located the first provincial school for bee culture in Prussia at Preetz, the city donating the site and making an appropriation of \$2,380 to establish the school. The well-known apiculturist, Witt-Havetoft, was appointed director. The first course, for young men who wish to become professional apiculturists, will open March 1, 1908, and close December 1. Short courses of from eight to fourteen days for older apiculturists are also to be held during the year.

#### INDIA.

The agricultural school at Cawnpore is now in process of development into a college, and will henceforth have a three-year course, instead of a two-year course, as formerly. A number of residences for members of the faculty have recently been erected, and plans for the extension of other buildings are under consideration.

In Ceylon there are now 117 government schools in which gardens are being carried on. The seeds and implements are supplied by the government, and the gardens are visited as often as possible by the superintendent of school gardens and his assistant.

#### KOREA.

J. Arthur Thompson, a graduate of the College of Agriculture of the University of Illinois, is on his way to Korea to assist in the establishment of an agricultural and industrial school. He is being sent by the Methodist conference; and spent a year at Hampton Normal and Agricultural Institute preparing for the work. The people of Korea have raised \$1,000 to establish the school, and the land has been purchased. On his arrival at Songdo, Korea, Mr. Thompson will begin his new work at once, assisted by Mr. T. H. Yun, a native Korean educated in the United States.

## SERVIA.

The consul at Belgrade reports that "there are in addition to the experimental farms at which instruction in agricultural subjects is given, three agricultural schools in Servia, as follows: (1) School of general agriculture at Kraljevo, (2) school of viticulture and arboriculture at Bukovo, and (3) school of agriculture at Sabac. Near Belgrade the government has a model farm, on which the best methods of farming are shown to the peasants and experiments are made as to the best grains, etc. In 1902 an experimental farm was established at Dorbricevo for the purpose of breeding animals. The government gave 1,000 hectares for this farm. After the almost total destruction of the vineyards by the phylloxera in 1882 the government established vineyards in order to restore this industry by experimenting. There were in 1905 six of these experimental vineyards. A considerable quantity of vines are given gratis to the cultivators, and those vineyards that resist the phylloxera are exempt from taxes for ten years.

At Smederevo (Semendria) there is also a dairy farm, established in 1903, which manufactures three grades of excellent cheese and offers special courses of instruction annually.

## SOUTH AMERICA.

An advisory commission has reported to the minister of agriculture of Argentina a scheme for a system of agricultural education in that country, including different grades of theoretical instruction in agriculture, schools for instruction in special branches of agriculture, practical instruction in agriculture, etc., and has drawn up a proposed law embodying its recommendations.

The Boletim da Agricultura, Viacao, Industria e Obras Publicas of Bahia, Brazil, announces the establishment this year of an agricultural institute under the direction of Dr. L. Zehntner. Plans are under way for the establishment of a department of agriculture and animal husbandry in the Province of Buenos Ayres. A bill introduced into the local legislature provides for the establishment of such a department January 1, 1908, under the direction of the minister of public works, to consist of divisions of agriculture and animal husbandry. Six practical schools of agriculture and animal husbandry, which will also give instruction in forestry, are provided for, and an extensive inspection service. A commission of 5 members, one of whom must be an agricultural engineer and another a veterinary surgeon, is to be appointed by the President to determine the duties of the department, lay out a course of study for the agricultural schools, and draw up regulations for the controlling of animal and plant diseases.

The minister of industries and public works of Chile has ordered the establishment of a veterinary station under the direction of Francisco Calvanese in connection with the Practical School of Agriculture at Concepcion, similar to the station now connected with the Normal School of Agriculture at Santiago. A practical school of agriculture was opened at Talca June 29, 1906, under the directorship of Carlos Echeverria Cazotte. The school was started with an appropriation of \$71,000 for land and \$28,000 for equipment and maintenance. The director is also professor of agriculture and zootechny, and is assisted by professors of forestry, physical and natural sciences, engineering, viticulture, and the common elementary branches. Twenty-four students were enrolled at the opening of the school.

A recent bulletin of the department of colonization and agriculture in Bolivia announces that the legislature has appropriated \$8,200 for the establishment of an agricultural school at Cochabamba. The exact location of this school is now under consideration. It is the intention to develop this institution into a national institute of agriculture, with other institutions to be established in the country as follows: A practical school of agriculture and animal husbandry at Tarija, a viticultural and enological station or school at Cinti, a special school of tropical agriculture at Santa Cruz, an office or station of zootechny and veterinary medicine at Trinidad, and a special high-altitude agricultural school for La Plaz, Oruro, and Potosi.

#### SPAIN.

An act of October 12 provides for the establishment of an experiment field with irrigation equipment on the Santa Teresa estate, near Seville, for educational and experimental purposes, a laboratory and educational institution in connection with the agricultural school at Madrid, and an experiment field at Motril, in the Province of Granada. The organization and equipment of these institutions has been placed in charge of the state engineer for agriculture of East Andalusia, under the supervision of the general director of agriculture of the ministry of public works.

The United States consul-general at Barcelona reports the promulgation of a recent government order creating traveling schools of agriculture for the remote districts of Spain. The order provides for a course of experimental and practical instruction to be given every year by itinerant lecturers selected from the agricultural engineers of the district schools of agriculture located at Zaragoza, Jaen, Palencia, Badajoz, and Barcelona, and the two stations at Haro and Villafraanca del Panades.



## TRANSVAAL.

Vacation courses, comparable to short winter courses in American colleges of agriculture, were held during the three weeks following June 24 at the Rhodes University College. The subjects included veterinary science and diseases of stock, breeding of Merinos and Angoras, agricultural chemistry, agricultural geology, farm irrigation and dam construction, law of water and water rights, plant diseases, ostrich raising, insects and insect control, mechanics and meteorology, and farm surveying and leveling.

**EDUCATIONAL WORK OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.**

This association held its twenty-first annual convention at Lansing, Mich., May 28-30, 1907. The convention was the most notable one in the history of the association in that it actively participated in the celebration of the fiftieth anniversary of the pioneer agricultural college of this country. It was an important day for all of these institutions—not merely one for self-glorification, but for sober consideration of the place which they should hold and are filling in American education, the outlining of high conceptions and standards of the mission and the duties of these institutions in a broad way, and the means by which these ends may best be met. These considerations lent a special value to the proceedings of the convention, and taken with the account of the celebration as a whole, to be published separately, will form a most interesting chapter in the history of the land-grant colleges.

The annual presidential address was delivered by Director L. H. Bailey on the evening of the first day of the convention upon the subject, The State and the Farmer, which he discussed from the standpoint of self-help and governmental assistance. He laid much stress on the importance of personal and local initiative in solving difficulties and effecting reforms, and discussed the general question as to what it is wise and just for the State to do in aid of the farmer.

His remarks dealt with the leading questions relating to the improvement of agriculture as an industry, the men connected with it, the conditions of country living, and similar educational and economic aspects. This led to a consideration of the various agencies of the State and of the nation for agricultural advancement, the respective functions of these agencies and their relationships, with an attempt to outline a logical and efficient system extending from the National Government to the individual farmer. The address was suggestive rather than exhaustive, and outlined so sharply many of the problems for future solution that the association voted to have it printed at once for distribution.

The report of the bibliographer, Dr. A. C. True, took the form of brief historical notes on some early agricultural text-books, the status of instruction in the natural sciences fifty years ago, an account of a convention held in Chicago in 1871, which is said to have been of marked influence in the inauguration of experimental work, and a résumé of the work of Dr. Albrecht Thaer, of Hanover, Germany (1752-1828), one of the founders of the present system of agricultural education in Europe, and indirectly a factor in that of this country. In the discussion that followed other data of similar nature were brought out, and much interest was shown in the general subject. It was urged that a complete history of the agricultural educational movement in this country should be brought together at an early date, and a committee, consisting of Doctor True, Dean Davenport, and Dean Henry, was appointed to take charge of this matter.

The report of the committee on instruction in agriculture, presented by Doctor True, as chairman, stated that a series of exercises for elementary instruction in agronomy had been prepared and published as Bulletin 186 of this Office. A more advanced course in agronomy, supplementing this and designed for the use of secondary schools of relatively high grade, had been made ready for publication.<sup>a</sup> The preparation of similar elementary and secondary courses in animal production and related topics is to be undertaken. The subcommittees on college courses in rural engineering and home economics reported progress.

The report of the committee on graduate study, submitted by President M. H. Buckham, stated that preliminary arrangements had been made to hold the next session of the Graduate School at Cornell University and the New York State Experiment Station, in the summer of 1908, with Doctor True as dean. (See Graduate School of Agriculture, p. 259.)

President K. L. Butterfield reported for the committee on extension work that a circular letter had been sent to the heads of the land-grant colleges, calling attention to the recommendations presented at the previous convention relative to the establishment of departments of extension teaching in agriculture. Replies received from 42 institutions, representing 39 States, were briefly summarized to show the status of the work in each case. Such departments are now formally established in six institutions, and in three others faculty committees have been appointed to study conditions and methods. Several institutions are hopeful of organizing the work in the near future, while at several extension work is proceeding along other lines. A more extended account of the work of this committee is given in the report of the Farmers' Institute Specialist of this Office (p. 312).

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<sup>a</sup> This course has since been published as Circular 77 of the Office of Experiment Stations.

In connection with the extension work the need of a central agency to concentrate and correlate the efforts of the different institutions was emphasized by a number of speakers, and the following resolution was adopted:

Whereas there has been a large expenditure of money and energy in the acquisition of knowledge of rural affairs and in the organization of country life education in collegiate, secondary, and primary schools; also in short courses, in farmers' institutes, in traveling schools, and in other forms of extension instruction; and

Whereas there is now manifest a determination on the part of the American people to rapidly multiply the agencies for extending this kind of practical education: Therefore be it

*Resolved*, That the Association of American Agricultural Colleges and Experiment Stations urges upon the Congress liberal appropriations to enlarge the work of the Office of Experiment Stations along the lines of investigations and publications in relation to methods of [technical] instruction in agriculture relating to the farm, to the farm home, and to rural interests generally.

Prof. Robert Wallace, professor of agriculture and rural economy in the University of Edinburgh, at the invitation of the association gave an interesting talk on the live stock of Great Britain, prefacing this with remarks on agricultural education in the United Kingdom. Remarks were made by Prof. S. B. Green and President G. E. Fellows in advocacy of securing national aid to the land-grant colleges for the establishment and maintenance of forestry courses through the receipts from forest reserves. The importance of more adequate State aid in such matters was emphasized by Dean Davenport.

Dr. Elmer E. Brown, Commissioner of Education, gave a notable address on The Development of Agricultural Education, in which he summarized briefly the evolution of the agricultural colleges and allied agencies, and gave his interpretation of the agricultural education movement and its outlook. In his judgment the real and lasting strength of agricultural education is to be found not in isolation but in close coordination with general education and through this with the real life of the people. His ideal of agricultural education and of other education as well, was outlined as follows:

A system of schools complete in its sequence from the lowest to the highest, in which the study of books is closely joined with training for some of the practical arts of life; in which all practical training is kept in vital touch with general education; in which the ability to form sound and stable judgments is sought throughout as a thing of very great price; in which the higher schools send into the lower schools an unbroken succession of teachers who both know the truth and are able to bring others to a knowledge of the truth; and in which, finally, the stream of knowledge fresh and new, from some department of pure research, shall never fail to keep fresh and bright the old wisdom of the ages gone before. Or, in more concrete statement, our elementary schools and high schools in country communities are still to be primarily schools of general education, but with much more of training in the arts of the farm and the sciences lying near to those arts; our State colleges of agriculture and

mechanic arts are to prepare young men and women to read intelligently the literature of scientific agriculture to form independent judgments in agricultural matters, and to bring their new knowledge into connection with the real work of the farm; these State colleges, moreover, are to provide well-trained teachers of agriculture and related subjects for the elementary and secondary schools; the colleges of agriculture, still further, are to be cooperative educational institutions and not merely special and local institutions—they are to cooperate with similar institutions in other States in order that the work of one may be strengthened by the work of all and cooperate with the universities of their several States for the innumerable advantages to both which may come from such united effort.

The National Department of Agriculture is undoubtedly to continue its remarkably wide and influential work, its expert investigations, the issuance of manifold and vastly useful publications, and its furtherance of all manner of agricultural education and research in the several States. Finally, the Bureau of Education is to do as thoroughly as possible the part of this work assigned to it. It can do its best work, I think, as a coordinating influence. It can bring to the notice of the less-favored institutions information concerning the experience of more advanced institutions. It can call attention from time to time to the relation of agricultural education to general education. It can survey the educational field and possibly point out dangers to be averted or weak places to be strengthened. It can, finally, discover things that need the doing and are not attended to by any other agency, and can see that some part of such lack is supplied.

The programme of the section on college work and administration dealt largely with problems relating to administration and curriculum. The question of securing State support for land-grant colleges was presented by President Fellows and discussed by Dean Henry and President Stimson. A better appreciation by the public of the work and needs of the institutions was considered the chief desideratum. Among the agencies which had been found helpful in securing this by bringing the public into closer touch were mentioned the better farming railway specials, the running of excursions to the colleges, summer schools, short winter courses, and the enlistment of the farmers' organizations.

The Selection and Retention of an Efficient Teaching Force was discussed by President W. E. Stone and others. A considerable divergence of opinion developed as to the most satisfactory means of securing men, some preference being expressed for their training and advancement at a single institution, while others favored securing the best men wherever found. Transfers of instructors from one institution to another during the college year were deprecated, and the necessity of maintaining among instructors a feeling of permanency of tenure during good service was emphasized. A certain flexibility of salaries and the treating of each case individually was also recommended as beneficial in many instances. It was believed that much can often be accomplished even with low salaries by arranging congenial work and by providing adequate funds for the maintenance of the departments.

Special interest in this section centered around the question of the preparation of instructors for teaching the elements of agriculture and the mechanic arts as authorized by the Nelson amendment. President White opened the discussion calling attention to the rapid development of agricultural education in the secondary and primary schools and the great dearth of competent teachers. The feasibility of preparing such instructors in the land-grant colleges was considered, and also the relations of these institutions to the normal schools in such work. President Bryan, of Washington, described the department of education in the Washington State College. He emphasized the necessity of supplementing instruction in the purely agricultural phases by the study of general pedagogic methods, and regretted that so little interest in agricultural education thus far had been taken by trained educators. President Butterfield outlined the scope and purpose of the department of agricultural education recently established in the Massachusetts Agricultural College, and Prof. C. B. Waldron, of North Dakota, described the three years' teachers' course in that State. Doctor True pointed out certain fundamental distinctions in the attitude of the land-grant colleges and the normal schools toward agricultural education. In his opinion the fullest development was to come through a serious co-operation of all available agencies, including the colleges, the normal schools, the Department of Agriculture, and the Bureau of Education. A short history of an attempt to introduce elementary agriculture into the rural schools in Scotland and its failure by reason of the withdrawal of the government grants was presented by Professor Wallace.

A paper on Extension Work in Agriculture was presented by Prof. F. H. Rankin, of Illinois, who described salient features of that work, its significance, and profitable lines of development.

The Short Practical Course, Its Value and Importance, was discussed by Dean Curtiss. A letter of inquiry showed that such courses were conducted last winter in 34 of the 39 colleges reporting, with a total enrollment of 7,776 persons, an average of 228 to each State. Opinions as to the value of the work were highly favorable, though its limitations as an educational agency are generally recognized. As a means of strengthening the institutions in clientage and public confidence their existence seems to have been fully justified. The present is apparently a period of transition, with a tendency to reduce the amount of the more extended short-course work and to place greater emphasis on that of college grade—a condition likely to be accentuated by the development of agricultural instruction in secondary schools. In the speaker's opinion, still further abbreviation of the short courses was to be expected and their eventual classification with extension work.

### THE GRADUATE SCHOOL OF AGRICULTURE.

Early in the year the committee on graduate study of the Association of American Agricultural Colleges and Experiment Stations decided to accept an invitation to hold the third session of the Graduate School of Agriculture at Cornell University, Ithaca, N. Y., and the New York Agricultural Experiment Station, Geneva, N. Y. Director A. C. True, of this Office, was again selected as dean of the school, and Prof. G. N. Lauman, of Cornell, was appointed registrar.

Director True and the committee on graduate study have outlined courses adapted to the needs of graduate students under the general heads of biochemistry, agronomy, horticulture, dairy husbandry and dairying, poultry, veterinary medicine, and entomology. A faculty of about fifty eminent specialists from different parts of the United States, one from England, and one from Germany, has already been selected, and others will be added.

Lecture periods of one hour each will be provided for, principally in the forenoon during five days of each week. In the afternoon seminars or demonstration exercises will be held for about two hours, five days in each week.

On Saturdays general conferences or excursions will be given, and the following have been tentatively planned: Conferences on agricultural pedagogics and secondary agricultural schools, excursions to typical New York horticultural plantations and dairy farms, and a general visitation of the New York Agricultural Experiment Station at Geneva, N. Y.

Public exercises and other meetings will be held on Wednesday and Friday evenings during the session, including a reception by the director of the College of Agriculture of Cornell University, and meetings for the discussion of general topics, such as agriculture in elementary schools, demonstration and extension work, student organizations in agricultural colleges, and the editing of college and station publications.

### THE AGRICULTURAL COLLEGES.

In 1907 agricultural colleges were in operation in all the States and Territories except Alaska, Hawaii, and Porto Rico. The legislature of Hawaii has passed an act providing for the establishment of a college of agriculture and mechanic arts. Including the separate colleges for negroes in the Southern States, there were 62 agricultural colleges in which regular instruction in agriculture was given and one additional college which conducted a number of farmers' institutes or traveling short courses in agriculture. The number of white students in four-year agricultural courses in 1907 was 3,738, a gain of 827 students, or 28 per cent over the attendance in 1906. There were also 5,334 white students in shorter courses in agriculture and

1,659 negro students in agricultural courses, making a total of 9,723 students enrolled in agricultural courses. This is the largest number ever enrolled in agricultural courses in the United States.

#### FIFTIETH ANNIVERSARY.

It is fifty years since the first State agricultural college in the United States opened its doors to students, and in many ways the year has been a notable one in the progress of agricultural education.

An event which attracted world-wide attention was the celebration during the week of May 26 of the semicentennial of the opening of the Michigan State Agricultural College, which occurred May 13, 1857.

The event was of great significance, not only because it marked the fiftieth anniversary of the pioneer agricultural college in this country, but also because it was the anniversary of a new type of education, which was characterized by President Roosevelt in a notable address on the last day of the celebration as the education which creates "as intimate relationship as possible between the theory of education and the facts of actual life." It is a type of education which has found expression in the establishment of institutions similar to the Michigan Agricultural College in every State and Territory and in liberal appropriations from both Federal and State governments for the support of these institutions.

The celebration brought together a large number of alumni of the college, representatives of the Michigan State government and her educational institutions and societies, delegates from universities and land-grant colleges and agricultural experiment stations in other States and Territories, representatives from foreign nations, and representatives of the Federal Government, including members of Congress, the Commissioner of Education, the Secretary of Agriculture and other officers of the United States Department of Agriculture, and the President of the United States.

The programme of the week was so arranged that delegates attending the convention of the Association of American Agricultural Colleges and Experiment Stations, which was held in Lansing during the same week, could be present at all sessions which would be of interest to the general public.

The programme of the first session related to the college and State and included addresses by the governor of the State and representatives of various agricultural and engineering societies, normal schools, denominational colleges, and the State Board of Education. The afternoon session of the same day was given up to addresses by some of the early alumni concerning the builders of the college, and in the evening the college chorus rendered Mendelssohn's oratorio, "Elijah."

On Thursday morning, the second day of the celebration, the programme consisted of addresses by the Commissioner of Education, the president of Purdue University, and the director of the Geneva (N. Y.) Experiment Station, relating to the development of agricultural and engineering education and research work in the land-grant colleges. In the afternoon Memorial Day exercises were held and in the evening a reception to delegates was given and the campus was illuminated by the students.

On Friday, the last day of the celebration, the morning session consisted of congratulatory addresses from other institutions and learned societies, an address by the Secretary of Agriculture, and addresses by the presidents of the Michigan University, Connecticut Agricultural College, Georgia College of Agriculture and Mechanic Arts, University of California, and the University of Illinois. In the afternoon President Roosevelt gave an address on *The Man Who Works with His Hands*, after which the degree of bachelor of science was conferred upon members of the graduating class, and honorary degrees were conferred upon alumni of the college and other leading educators.

For the Michigan Agricultural College the occasion was one for rejoicing and congratulation, in which the faculty, alumni, and students of the college were joined by their guests from other States and other countries. For all who attended it was an occasion for reminiscence, for weighing, measuring, and otherwise estimating this new education which seeks to provide for the people on the farm and in the shop "an equipment so broad and thorough as to fit them for the highest requirements of our citizenship," and which would make the ordinary graduate of our college "primarily a man and not a scholar."

#### APPROPRIATIONS.

Another event which is deeply significant of the permanent progress of the agricultural colleges and of the high esteem which their work commands was the passage of the Nelson Act giving increased Federal funds to these institutions. This act reaffirms the policy of the Federal Government, as previously expressed in the land-grant act of 1862 and the second Morrill Act of 1890, to favor and develop these land-grant institutions.

The act of 1862 donated to the States and Territories lands from which over \$12,000,000 has been realized as a permanent endowment, with over \$4,000,000 worth still unsold. The supplementary act of 1890 has given them \$1,200,000 annually for more than a decade past, and the present act, known as the Nelson Act, increases the amount to each State \$5,000 a year for five years, when the appropriation wi



be \$50,000 a year and will be continued permanently at that rate. Although the new measure is carried by the agricultural appropriation act, it will be administered, like the Morrill fund, by the Bureau of Education, and not by the Department of Agriculture.

The appropriation was carried through on the merits of agriculture. The law itself mentions the agricultural work prominently, and the discussion in Congress hinged almost exclusively on the value and growing importance of agricultural education and the needs of developing that phase of our educational system.

The State legislatures have also appropriated liberally—some of them more liberally than ever before—for the equipment and maintenance of their agricultural colleges. In Kansas, for example, appropriations aggregating \$544,000 for the college and \$57,000 for the Fort Hays substation have been granted by the legislature for the next biennium. The appropriations include \$70,000 for the erection and equipment of a building for domestic science and art, a like sum for a veterinary building, \$80,000 for an engineering building, and \$11,500 for farmers' institutes. The aggregate is one-half as large as the entire amount given by the State during the previous forty-four years' history of the college.

The Tennessee legislature made an appropriation of \$100,000 for the next biennium. Of this amount, \$25,000 is to be used for salaries, \$40,000 for an agricultural building, \$22,000 for repairs and equipment, \$3,000 for the transportation of the holders of scholarships, of which three have been established for each member of the legislature, and \$10,000 for cooperative experiments in agriculture and agricultural extension work in middle Tennessee. A separate bill also appropriates \$40,000 for the establishment of a permanent substation in west Tennessee.

In Texas the total appropriation for the college and station for the ensuing biennium aggregates \$346,370, by far the largest appropriation in the history of the college. Of this amount \$2,000 is for publications and \$14,000 for the two substations. The remainder is for repairs and new buildings, including a farm-implement building to cost \$4,000, a dormitory, an engineering building, a natatorium, a veterinary hospital, and live-stock sheds. The increased appropriation will enable the college to strengthen much of the work already under way and to establish new departments, especially a department of agricultural extension work.

In Washington an appropriation aggregating \$575,754 has been made by the State legislature for the ensuing biennium. Of this, \$130,000 is for a library and auditorium, \$125,000 for a general recitation building, \$25,000 for a domestic-economy building, \$12,000 for an engineering laboratory for hydraulics and irrigation, \$11,000 for

a wing to the veterinary hospital, \$12,000 for additional farm lands, \$7,000 for barns, \$10,000 for farmers' institutes, \$4,000 for investigations with cereals and in dry-land farming, \$2,500 for irrigation investigations, \$20,000 for the Puyallup substation, and the balance for maintenance.

In order to relieve the crowded condition at the Alabama College, the total enrollment of which has now reached 600 students, the legislature has made an appropriation of \$56,500 per year for the next four years to be used exclusively for buildings and equipment. Of this amount, \$75,000 is to be expended in the erection and equipment of an agricultural building for the joint use of the college and station. In lieu of fees heretofore derived from the analysis of fertilizers, a fixed annual appropriation for maintenance has been made approximating in amount that previously obtained.

The Connecticut College has received a State appropriation of \$50,000 for new greenhouses and a horticultural building. The old greenhouse has been turned over to the station and will be a valuable addition to its equipment.

The Delaware State legislature has authorized the issuing of \$20,000 worth of State bonds, the proceeds of which are to be used for purchasing and equipping a farm for the use of the college and station. A legislative commission was appointed to purchase the farm and turn it over to the agricultural committee of the board of trustees. This commission has selected a farm of 220 acres, situated about a mile from the college.

The last legislature in Florida, which adjourned June 1, appropriated \$570,711 for higher education during the next biennium. The State board of education, which has general supervision and allotment of this fund, has decided to allot \$150,000 to the university for buildings, \$40,000 of which is to be used for the construction of laboratories and offices for the station. For the ensuing biennium \$10,000 has been set aside for farmers' institutes and \$5,000 for farm buildings and improvements on the station grounds.

An appropriation of \$130,000 has been made by the legislature of Maine for maintenance of the university during the next biennium, besides \$90,000 for new buildings, including an agricultural building and a central heating plant.

In Montana increased appropriations for maintenance during the next biennium and for new buildings were made by the legislature at its recent session. The college received for maintenance \$50,000, an increase of \$14,000, besides an appropriation of \$80,000 for an agricultural building.

The Nebraska legislature has appropriated \$100,000 for new buildings and improvements, including \$20,000 for the completion of the woman's building, \$35,000 for a heating and power plant, \$30,000 for

a stock and grain judging pavilion, and \$15,000 for a steer-feeding plant, tool barn, houses, etc.

The new appropriation for the New York State College of Agriculture carries \$150,000 for maintenance, \$50,000 for equipment, and \$25,000 for building barns, a total of \$225,000 for the year.

The Pennsylvania legislature passed a deficiency bill for the college amounting to \$179,530.92, which included \$85,000 for the completion of the new agricultural building. The contract for finishing the new building has been let. The total appropriations for the agricultural and dairy buildings, including the heating tunnel, have been \$284,169.60. The general appropriation bill for the college carried \$274,000. A special item of \$70,000 was included in the bill for the school of agriculture and \$4,000 for experiments on tobacco by the station.

The Utah legislature adjourned March 22 after a session during which a determined effort to unite the college with the State university, either by consolidation on one site or by means of a joint board with separate maintenance, was unsuccessful. The appropriations for both college and station were much reduced. For the next biennium \$90,000 was appropriated for the college, \$10,000 for investigations in dry farming, and \$5,000 for investigations in irrigation and drainage in cooperation with this Office.

#### BUILDINGS.

##### MINNESOTA.

It is nearly twenty years since the Minnesota School of Agriculture was established in 1888 at St. Anthony Park as a branch of the department of agriculture of the State University. Prior to that time there had been very few students in the College of Agriculture and no State agricultural high school had ever been successfully conducted. The progress in two decades is remarkable. In 1907 there were 747 students in the School of Agriculture and 72 students were taking the full four-year course in the College of Agriculture. Another striking indication of progress is found in the buildings of twenty years ago as compared with those of to-day. In 1888 the "Old Home" building was erected on the campus of the college and school at a cost of \$17,000 (fig. 11). This building was considered of ample size for offices, library, class rooms, kitchen, dining room, and dormitory for principal, assistant principal, 50 students, and the hired help. Since 1888 several large buildings have been erected on the campus, among which may be mentioned the chemical laboratory, the horticultural building, the experiment station building, the dairy building, the veterinary laboratory, the animal husbandry building, a large barn, and finally a magnificent new administration building,

which has just been completed and equipped at a total cost of over \$250,000 (fig. 12).

This building is a dignified and imposing fireproof structure with basement and three stories, built in form of a T, with a frontage of



FIG. 11.—The "Old Home" building at the Minnesota School of Agriculture.

248 feet and a depth of 145 feet. Architecturally the building is early Italian in style, the materials used being brown pressed brick



FIG. 12.—Administration building of the Minnesota College and School of Agriculture.

trimmed with granite and Bedford stone. The roof is covered with red tiles. The main entrance is dignified by a stone portico of gen-



erous dimensions, the cornice is bold, and the general effect is one of massive but pleasing simplicity.

The basement of the building contains storage rooms and ventilating fans and heaters, the steam being supplied from a central heating plant in an adjoining building. The ground floor is devoted to offices and rooms for the division of agriculture, where generous allowance has been made for class rooms, laboratories, and work-rooms. A striking feature of the interior is the great stone entrance hall and stairway, finished in polished Kasota marble, which has also been used for the floors of the halls throughout the entire building.

The first floor contains the executive offices of the school, college, and experiment station; the library and reading room; seminary rooms; a farm accounts room, and a beautiful and spacious auditorium capable of seating 1,000 people. The second floor contains rooms for the entomological and sewing departments. The entire



FIG. 13.—Buildings of the New York State College of Agriculture. Reading from left to right: Agronomy; Main building; Dairying; Dairy manufactures; Animal husbandry.

building is finished in weathered oak, heated by a system of indirect radiation which furnishes abundant fresh warm air at all times, and lighted by electricity.

#### NEW YORK.

By act of the New York legislature approved May 9, 1904, an appropriation of \$250,000 was made for buildings for the College of Agriculture, and the act authorized Cornell University to purchase the dairy building erected by the State some years ago and to add the purchase price (\$40,000) to the appropriation, thus making a building fund of \$290,000. The buildings constructed under this act were dedicated April 27, 1907, in conjunction with the celebration of the centennial anniversary of the birth of Ezra Cornell, but were not entirely completed until later in the year. (Fig. 13.)

They consist of a group of three buildings connected by covered loggias and a detached building to be occupied by the department of

animal husbandry. The main group of buildings, with a frontage to the south of 484 feet, occupies a site to the east of the original university campus, with commanding views in all directions. All the buildings are built of brick of various sizes and colors. The main building, central in the group of three, contains in the basement mailing and storage rooms for the publications of the college, a large lavatory with baths and lockers, and laboratories and storerooms for horticultural and other work. The heating plant for the buildings is also beneath this basement. A completely inclosed passage way leads to the basement of the dairy building and to the agronomy building.

The first floor of the main building contains the offices of administration, including the office of the director and the secretary, and the business office, to the west of the main entrance. To the east are the office for extension teaching, the library, and three seminary rooms. Between these two groups of rooms is the auditorium, seating about 600 on the main floor and the two balconies. The loggias on this floor are open at the sides, but covered above.

The second floor is occupied by the department of horticulture, with its lecture rooms and two laboratories, and offices for the staff; also two rooms for women's rest room and lavatory.

The department of entomology and general invertebrate zoology occupies the third floor, with its museum at the head of the stairway and the offices of the staff immediately beyond. The lecture room will accommodate 160. Quarters are provided for the new work in limnology. In the center of the fourth floor is a suite of rooms occupied by the central station, New York section, of the Weather Bureau of the United States Department of Agriculture. To the west are the offices of such branches of the extension work as nature study and farmers' wives reading course, and to the east provisions have been made for home economics and a suite of dark rooms with a general photographic operating room.

The dairy building to the east of the main building, and connected with it by three passage ways, is built in two sections. The larger two-story building contains in the basement locker rooms and lavatory with bath, rooms for instruction and practice in dairy mechanics and a room for a laundry. The main floor contains the general offices of the department and the large laboratories for dairy bacteriology, with the necessary incubator room and offices. A special reading room, which serves also in part as a museum, is provided. On the second floor is the large lecture room seating 200, with its preparation room and a smaller lecture room. The large milk-testing laboratory is also provided with a preparation room. The attic is being prepared to house the drawings required in the various courses of the college. Connected with this building is the section containing the manufacturing rooms. The milk-receiving room is at the far end

and connects with the separator room and the cheese-making room, as well as with a can-cleaning room. Between the separator room and the churn room is the cream-ripening room and the refrigerator for butter. Beyond the cheese-making room is a series of three curing rooms, the starter room, and a room for farm-dairy practice. Adjoining the main dairy building are the rooms for market-milk handling, and below these in the basement are large storage and refrigerator rooms. At one side of the rooms for cheese making and in the basement are the rooms for making fancy cheese, with additional curing rooms and a room for casein making. A boiler and engine room, with the necessary storage, complete the general features of the dairy building.

To the west of the main building and connected with it, as is the dairy building, by three passageways, is the agronomy building. The basement is devoted to instruction and exhibition of farm ma-



FIG. 14.—Main building of agricultural group, Pennsylvania State College.

chinery. The first floor contains a number of offices and the laboratory for soil study, while the feature of the second floor is the large laboratory for the study of farm crops. The experiment station also has a large laboratory for the study of the problems of fertility. The top floor will house the work in plant pathology and the experimental plant biology of the experiment station. Plant physiology is also accommodated in this building.

Detached from the main group of buildings to the northeast is the building for the department of animal husbandry, with its large judging pavilion, offices, lecture and laboratory rooms.

#### PENNSYLVANIA.

The group of agricultural buildings, which was dedicated at the Pennsylvania State College on November 22, consists of a main structure 158 by 73 feet, with basement, two stories, and an attic (fig. 14);



a dairy building 115 by 61 feet, with basement and two stories; and a one-story respiration calorimeter building 56 by 35 feet (fig. 15). The dairy building and heating tunnel cost \$124,000. The main structure cost \$160,000 and the calorimeter building, with equipment, cost about \$16,000, making in round numbers \$300,000 for the group. With the exception of the calorimeter building the structures are

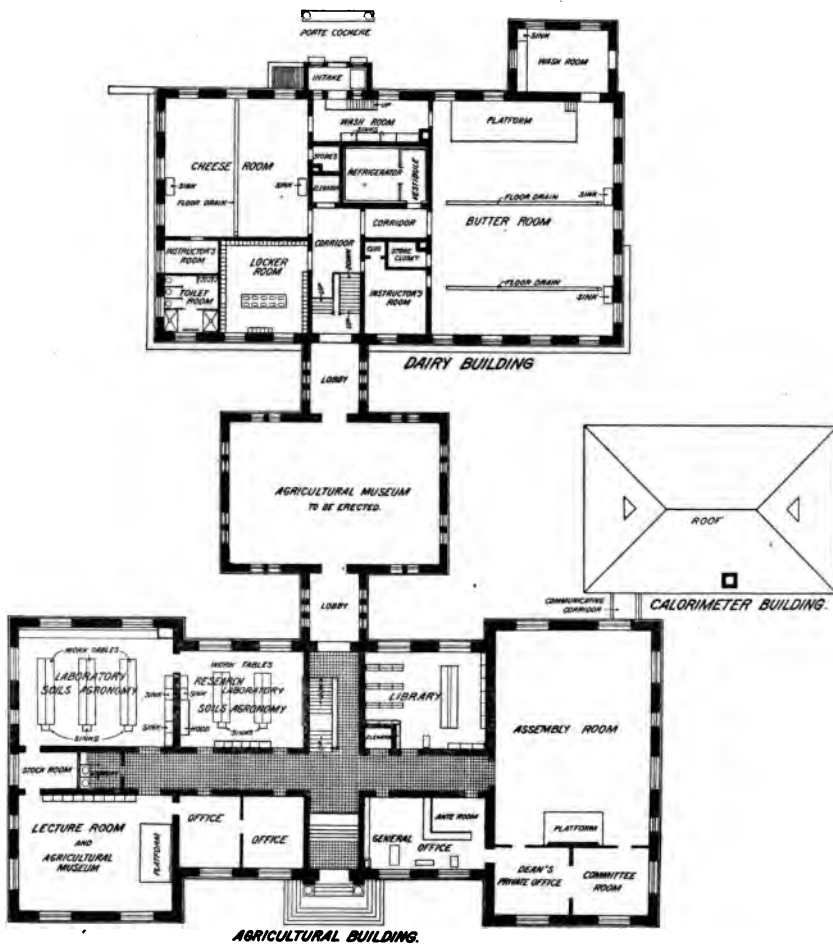


FIG. 15.—Plan of Pennsylvania group of agricultural buildings.

fireproof throughout and represent the highest type of construction. The base of the buildings is of Hummelstown brownstone, the superstructure of Pompeiian brick with terra-cotta trimmings. The roof of the main structure is roman tile, that of the dairy building is slate. The windows are plate glass throughout both buildings.



The west end of the basement of the main building contains a judging room for live stock, facilities for demonstrating the methods of handling meat, laboratory for farm machinery, and rooms for the mailing department. The east end of the basement contains the offices, library, and laboratories of the institute of animal nutrition. These laboratories connect directly with the building containing the respiration calorimeter used for the purpose of studying fundamental questions in the feeding of domestic animals. The west end of the first floor houses the indoor work of the department of agronomy, contains offices, class room and laboratory for field crops, a laboratory for the study of soils, and a research laboratory in agronomy. The east end of the first floor contains the offices of the dean and director, the school and station library, and an assembly room. On this floor is also the office of the department of agricultural extension. The west end of the second floor contains a large class room and offices for the department of animal husbandry and the correspondence courses. In the central portion of this floor the departments of horticulture are temporarily located, while at the east end are located the offices, laboratories, and class room of the department of agricultural chemistry. The equipment is elaborate, and portions of the attic have been also furnished for this department. The dairy building contains a creamery department with various rooms and all modern equipment for making butter, handling sanitary milk, and the preparation of ice cream, a cheese-making room with vats, presses, and other necessary equipment, room for instruction in farm dairying, milk testing laboratory, bacteriological laboratory, and several offices and class rooms.

When the necessary appropriation is made by the legislature, it is the intention to construct an agricultural museum and lobbies between the main building and the dairy building, thus providing proper communication for the two main structures.

#### VERMONT.

Morrill Hall, the new \$60,000 agricultural building of the University of Vermont, was dedicated December 11, at the time of the meeting of the State Grange in Burlington. (Fig. 16.)

This building was designed by an alumnus of the university of the class of 1891. The basement is occupied by the dairy school, creamery, and farm-dairy rooms, milk-testing laboratory, market-milk room, power and heating plant, toilet and locker rooms, and storage room.

On the main floor on the right of the entrance are the agricultural chemistry laboratory, and the horticultural class room and office. At

the left of the entrance are the offices of the dean and director, the library, and the horticultural laboratories. Directly in front of the entrance are the laboratory and office of the dairy husbandman. On the upper floor are the chemical laboratories of the experiment station, the soil physics laboratory, and class rooms.

#### WISCONSIN.

The equipment of the Wisconsin College of Agriculture has been enlarged during the past year by the erection of two buildings for the use of the departments of agronomy and agricultural engineering.



FIG. 16.—Morrill Hall, the new agricultural building at the University of Vermont.

(Fig. 17.) The agronomy building, 48 by 96 feet, is two stories and basement high, and contains one large storage room for seeds and grains, a corn-curing room, in which seed corn is fire dried, grain-sampling room, one large, well-lighted corn and grain judging room, and offices. The agricultural engineering building is 50 by 150 feet, three stories high, and contains three large testing laboratories, a cement laboratory, two drafting rooms, and several class demonstration and recitation rooms and office. A large power elevator renders convenient the handling of heavy machinery. Both buildings are of fireproof construction, being built of reenforced concrete and brick, with tile roofs.

The greenhouses of the department of soils were entirely rebuilt the past fall, and are now available for purposes of instruction and research work. A new stave silo has been added to the facilities of the department of animal husbandry for the production of summer silage.

#### OTHER BUILDINGS.

Among other college building operations during the year may be mentioned a new agricultural building at the University of Idaho, three stories and basement, completed at a cost of \$45,000; a new \$350,000 four-story agricultural building at the Iowa State College, now in process of construction; a new veterinary-science building re-



FIG. 17.—Agronomy and rural engineering buildings, University of Wisconsin.

cently completed at the Kansas College at a cost of \$70,000; one wing of a new agricultural building begun at the Kentucky State College; a three-story fireproof chemical laboratory, to accommodate 1,000 students, costing \$40,000, at the Louisiana State University; a building for the botanical department of the Massachusetts Agricultural College completed at a cost of \$45,000 (fig. 18); a \$70,000 home-economics building, a \$30,000 heating plant, and a \$30,000 judging pavilion, nearing completion, at the Nebraska School of Agriculture; a \$24,000 building completed for the accommodation of short courses in agriculture at the New Jersey College; a cattle building, a stock-judging pavilion, and a horse building at the Ohio State University,



completed at a cost of \$80,000 (figs. 19, 20, and 21); a newly completed \$75,000 Morrill Hall at the Oklahoma College, for agriculture,



FIG. 18.—Clark Hall, new botany building, Massachusetts Agricultural College.

horticulture, and administration, and several buildings in process of erection at Washington State College, including one wing of a new



FIG. 19.—Cattle barn, Ohio State University.

veterinary building, a new farm barn to cost \$7,000, a new recitation building to cost \$125,000, a library and assembly hall to cost \$135,000,

and a domestic-science building to cost \$25,000. The facilities for instruction and reasearch at the Delaware College have been improved by the purchase of a farm of 217 acres.



FIG. 20.—Judging pavilion for live stock, Ohio State University.

#### WORK OF THE COLLEGES.

##### THE TRAINING OF TEACHERS.

One of the most important problems now engaging the attention of the colleges of agriculture is that of providing training courses



FIG. 21.—Horse barn, Ohio State University.

for teachers of agriculture in colleges and secondary and elementary schools. Such teachers are needed in 62 of the so-called land-grant colleges, in about 40 agricultural high schools, in many normal schools and public high schools, and in many rural elementary schools.

From a recent inquiry made by this Office it appears that there are now only six States and Territories from which information concerning definite encouragement of agriculture in the public schools is lacking, viz: Alaska, Arizona, Delaware, Kentucky, Nevada, and New Mexico.

It also appears that, of the 62 State colleges in which agriculture is taught, 26 now provide training courses for teachers of agriculture ranging from summer courses of a few weeks to regular four-year courses with additional graduate work.<sup>a</sup> Four-year courses for teachers are offered by 10 colleges, including colleges for whites in Arkansas, Illinois, Maine, Mississippi, Missouri, and Rhode Island, and schools for negroes in Missouri, South Carolina, Texas, and Virginia. Three-year courses are offered by the North Dakota Agricultural College and by the school for negroes in Florida. The agricultural colleges in Missouri, New York, and North Carolina give two-year courses and the latter also offers a one-year course for rural teachers of agriculture. Sixteen of the colleges<sup>b</sup> provide summer schools of agriculture for teachers, 4 (Massachusetts, Missouri, Pennsylvania, and Utah) are cooperating with other agencies, and 2 (North Dakota and Oklahoma) are conducting correspondence courses for teachers. During the year 1906-7 correspondence instruction in agriculture was given to 83 teachers and summer school instruction in agriculture to 925 teachers.

Several of the universities with which State colleges of agriculture are connected and one separate college of agriculture have regularly constituted departments of education or teachers' colleges and eight of these offer training courses in agriculture or electives in agriculture upon which full credits for degrees are allowed.

In some of these institutions the teachers' courses are organized on a very broad and thorough basis. The University of Missouri, for example, has a teachers' college in charge of a dean who is also professor of educational psychology. This college affords to advanced students preparation for college and normal school instructorships, for work as superintendents and principals of schools, and professional training, both theoretical and practical, for teachers in high schools and in elementary schools and for special teachers of technical subjects.

In order to supplement its class instruction in educational aims and methods, and to cultivate skill in meeting the actual problems of teaching and admin-

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<sup>a</sup> These include schools for negroes in Florida, Missouri, North Carolina, South Carolina, Texas, and Virginia.

<sup>b</sup> Summer schools for teachers are announced for 1908 at the agricultural colleges in California, Connecticut, Illinois, Kansas, Maine, Massachusetts, Minnesota, Mississippi, Missouri, North Carolina (both white and negro schools), Ohio, Tennessee, Utah, Washington, and Wisconsin.

istration, this college has developed as an integral part of its work a system of schools for observation and practice. The professor of theory and practice of teaching is the superintendent of these schools, and he is assisted in the work of supervision by the representatives of departments of instruction who hold positions in the faculty of the teachers' college.

The practical work, required in connection with all courses in theory and practice of teaching, consists of observation, assistance, and class instruction. All students who receive certificates from the teachers' college are required to demonstrate their ability to teach satisfactorily, under normal conditions, so that a certificate is practically a guaranty of efficiency. Advancement from observation to assistance and from assistance to class teaching depends upon the candidate's ability to do the work required.

Among the technical subjects offered by this college are one in agriculture and one in horticulture for those who are preparing to teach in elementary schools and one in agriculture and three in horticulture for high school and academy teachers. In addition, many of the technical courses offered in the college of agriculture may be elected in partial fulfillment of the requirements for the degree bachelor of science in education. The college also offers graduate courses leading to the A. M. and Ph. D. degrees.

The University of Missouri is one of the institutions which annually conducts a summer school for teachers, and it also cooperates with the Columbia Normal Academy in training teachers of elementary agriculture.

In the University of Illinois there is a department of education with ten courses, and in 1907 there was added a special instructor to teach agriculture to prospective teachers. The University of Arkansas offers a four-year normal course in which agriculture and horticulture are taught. The Mississippi College has a department of industrial pedagogy and offers a four-year course in industrial pedagogy, which includes agricultural subjects. The State College of Washington offers ten courses in education, including one course in methods of teaching agriculture. It also conducts a summer school for teachers.

The Massachusetts Agricultural College has a State appropriation of \$5,000 for the support of normal instruction, and has organized a department of agricultural education. President Butterfield writes that the purpose of the department is "to institute research and to give instruction to students in all those matters which have to do, (1) in general, with all the various phases of agricultural education; (2) in particular, with elementary agriculture suitable for teaching in primary and secondary schools, and (3) with those aspects of the rural school problem which are of special interest in rural social betterment." Continuing, he says:

It is intended that the teaching shall include normal instruction at the college for those students who are preparing to teach in agricultural schools and

colleges, and also for teachers desiring to prepare specifically for giving school garden work and elementary agriculture in primary and secondary schools. It is expected that the department will make a study of technical agricultural education, more particularly on its pedagogical side, including the work of agricultural colleges, agricultural high schools, agricultural courses and subjects in high schools and academies, agriculture in the lower grades of schools, and agricultural extension teaching.

The New York State College of Agriculture at Cornell University offers a highly specialized two-year course in nature study, which is "designed to prepare students to teach elementary agriculture." The work of the first year includes botany, zoology, entomology, physical geography, chemistry, nature study, and elective agriculture; that of the second year botany, zoology, entomology, soils, farm crops, nature study, and elective agriculture. Pedagogical practice is had with children in regular nature-study classes and clubs in the public schools of Ithaca and in school-garden work with children on the university grounds and in the forcing houses.

Hampton Institute, Hampton, Va., may be mentioned among the industrial schools doing effective work in training negro teachers of agriculture. A four-year course is given in which elementary science the first year prepares for agriculture in each of the three succeeding years. Girls, as well as boys, study agriculture, which includes both theoretical and practical work—school gardens, farm crops, poultry culture, animal husbandry, dairying, drainage, and irrigation. The training courses for teachers are thoroughly effective. Concerning this feature of the curriculum the institute catalogue makes the following statements:

The young women, almost without exception, and most of the young men who graduate engage in some form of teaching. The course of study therefore provides that all members of the senior class shall receive such preparation for teaching as can be gained during the year from one hour a day spent in observation and a study of principles based upon this observation. In addition to this, all the young women and such of the young men as may so elect gain practical acquaintance with public school work in a course of five hours daily for half a year. In preparation for teaching a course is given in special methods of teaching reading, language, arithmetic, geography, and nature study. Some time is devoted to psychology for the purpose of acquainting the students with the elementary facts concerning the mind and its activities and to form a basis for the principles of pedagogy.

Those who take the practical course in public school teaching devote their entire time for half a year to the preparation of lessons, study of method, and actual teaching. The Whittier School, with its four or five hundred children of all ages from the neighborhood, offers excellent opportunities for the training of teachers under natural conditions. Each teacher in training is put in charge of a group of children—there may be more than one grade in a group—and is responsible for the teaching and control of the room. The pupil teachers also assist in teaching sewing, cooking, manual training, and gardening. Several members of the class have an opportunity to teach these subjects in a social set-



tlement in the neighborhood. The aim is to give to those preparing to teach such professional equipment as shall enable them to go into the schools of the South and teach the usual subjects in a strong way, and to introduce such industrial work as may raise the standard of living in the community.

Hampton also offers several graduate courses, among which are agricultural and teachers' training courses. The latter is intended to give—

(1) A more extended academic training than the undergraduate academic course offers; (2) some acquaintance with the principles underlying the best school practice through a study of psychology, pedagogy, school management, and the history of education; and (3) actual experience in teaching and managing classes in the Whittier School or at the institute.

Lincoln Institute, Jefferson City, Mo., is another school for negroes which offers a four-year normal course. A good grammar school course is necessary before a student can enter this course, and two years of agriculture or some other industrial subject are required for graduation. Those who take agriculture spend half the time in the study of the theory as given in the text-book and the other half in the practice and application of the theory to the work on the farm. Two years of practice teaching in the training school are afforded junior and senior students.

Four-year normal courses with instruction in agriculture are also offered by the schools for negroes at Orangeburg, S. C., and Prairie View, Tex.

Noteworthy among the developments of the year are the outlining of four-year courses for teachers at the agricultural colleges in Maine and Rhode Island, of a three-year course at the North Dakota Agricultural College, and of two-year and one-year courses at the North Carolina Agricultural and Mechanical College. Massachusetts has organized a department of agricultural education and held a summer school for teachers with 212 enrolled. Wisconsin held a summer school for teachers of agriculture with 20 young men enrolled, and plans to continue the work and also to offer agricultural courses in the school of education. Tennessee has added an assistant professor of agricultural education to its staff. Kansas has made definite plans for a six weeks' summer school in 1908. Sixteen other colleges, which are now doing nothing for the training of teachers of agriculture, have more or less definite plans along this line to be put in effect this year or in the near future.

A decided impulse to the work of training teachers in the agricultural colleges has been given by the clause in the "Nelson amendment," which makes it permissible for these colleges to devote a part of their increased Federal aid to "the special preparation of instructors for teaching the elements of agriculture and the mechanic arts."

## THE COLLEGES AT THE INTERNATIONAL LIVE STOCK EXPOSITION.

The influence of the agricultural colleges was strongly felt at the seventh exposition of the International Live Stock Association held in Chicago in December, 1906. A considerable number of the judges were taken from college ranks, and their exhibits attracted widespread interest. Previous to the exposition a petition had been sent in by exhibitors to debar the colleges and stations from the open competitions, but this was not granted, and in nearly all classes a large proportion of the prizes fell to their share.

In the fat-stock division their predominance was especially marked. In the display of fat barrows Ohio State University furnished the champion Berkshire, and Iowa State College the champion pen of three. In Poland Chinas and Duroc Jerseys all championships went to Iowa. North Dakota took a second on a pen of large Yorkshires, and Wisconsin a first and second and the championship for the Tamworths. The grand championship for a pen of three barrows, all breeds, was awarded to Iowa. In dressed hogs Wisconsin was first for carcasses of 300 pounds and over. Iowa took second in this class and first for carcasses from 200 to 300 pounds in weight.

For fat wethers Wisconsin took two seconds and a third for Shropshires, second on a pen of five lambs of Southdowns, and third for yearling Hampshires, and in Cheviots first for yearlings, second and third for lambs, first for a pen of five, and the breed championship, besides 11 prizes for grades and cross breeds. Iowa was awarded first for yearling Oxfords. For dressed sheep Iowa took second and third for wethers, and Wisconsin first for lambs and the champion carcass of the show.

In fat cattle Kansas took a first and two fourths for Shorthorns, besides a second on herd. Nebraska received a second, Purdue a second and third, and Ohio a first. Iowa and Minnesota won first in the Hereford class, and Purdue a fifth. For the Aberdeen Angus, Minnesota carried off first for 2-year-olds and yearlings and the breed championship for single steers and herds. Kansas took first in Angus calves, and Nebraska a fourth. Ohio won first for 2-year-olds and the breed championship with Galloways, Minnesota receiving a third. In the 2-year-old class for grades and crosses Kansas won first, North Dakota second, and Iowa fifth.

For senior yearlings Ohio was second and Minnesota third, and for junior yearlings Iowa took first and fourth, Purdue and Kansas capturing second and third. Nebraska was first in the class for junior calves, Iowa third, and Purdue fourth. Iowa won first and fifth for herds, and the champion herd of the show for all breeds was from Minnesota. For the first time in the history of the show, grand championship honors went to a calf, Peerless Wilton 39th's Defender,

a Hereford, since sold to the Iowa College. The second choice was an Angus yearling, Andy, owned by the Minnesota Station.

In the breeding-stock section the entries from the colleges were less numerous. Purdue secured a third on aged Shorthorn bulls, and Wisconsin and North Dakota carried off several special prizes for American Rambouillets. In response to a general demand from swine breeders, arrangements were made whereby the classes for breeding swine, which were discontinued two years ago because of the danger of transmission of infectious diseases, are to be restored under certain restrictions.

The special classes for college and station stock were again continued, and resulted in an even larger number of entries and sharper competition than ever. In the class for 2-year-old cattle Nebraska was first, Minnesota third, and Kansas second and fourth. For yearlings Minnesota took first, second, and fourth, and Nebraska third. Kansas took first and third for calves, Minnesota second, and Nebraska fourth. For a pen of five steers the first place went to Minnesota. Nebraska furnished the champion of the college steers, Ruby Zenoleum. Wisconsin was awarded all prizes for sheep. For swine Iowa received first for a barrow under twelve months, Ohio second, and Wisconsin third. For a pen of five Iowa was first, followed by Wisconsin and Ohio, and the champion barrow was from Iowa.

As in previous years, the students from the colleges were most liberally represented. Iowa, Illinois, and Minnesota sent over 100 each, and smaller delegations came from Virginia, Wisconsin, Indiana, Ohio, Michigan, Missouri, Texas, Colorado, Nebraska, North Dakota, Kansas, and Ontario. During the exposition the American Federation of Agricultural Students held an enthusiastic meeting.

The students' stock-judging contest was participated in by six institutions. Ontario Agricultural College led in the work with cattle and sheep, and once more scored the highest total of points, followed by Iowa, Ohio, Kansas, Michigan, and Texas. Iowa won back from Ohio the horse-judging trophy, and Kansas made the best record with swine. The corn-judging team from Iowa succeeded in maintaining its hold on the Cook bronze trophy, Kansas receiving second and Missouri third.

A new form of intercollegiate competition was inaugurated by the Chicago Daily Live Stock World, which offered \$300 in twenty cash prizes for reports by students of the various sections of the exposition. The best showing was made by the Iowa men, who won first and second for cattle, first and fourth for swine, first, second, and third for horses, and fourth for sheep.

One of the most noteworthy features of the exposition was its international aspect. King Edward and Lord Rothschild were

among the competitors in the horse-breeding section. Sheep were entered from England, and Canada sent cattle, horses, sheep, and swine. In the crowd of spectators were visitors from England, Scotland, and the Argentine Republic, and the agricultural departments of Nova Scotia, Quebec, Ontario, and Hawaii were officially represented. The announcement was made by the German consul that after careful investigation he had advised his Government to enter exhibits in the future.

The agricultural colleges and their students are also taking prominent part in other agricultural expositions. At the first annual show of the Northwestern Live Stock Association, held at St. Paul, November 19 to 22, 1907, the North Dakota College won a large number of prizes, especially in the swine classes, and the Minnesota College of Agriculture had a notable exhibit, though not entered for competition. W. J. Kennedy, of the Iowa College and Station, was one of the judges, and among the speakers and demonstrators from the colleges and stations were J. H. Shepperd, of North Dakota; Director Randall, D. A. Gaumnitz, and M. H. Reynolds, of Minnesota, and A. T. Peters, of Nebraska. A student stock-judging contest, in which four colleges participated, resulted in the award of first and third places to Minnesota, second, fifth, and eighth to South Dakota, fourth and seventh to Washington, and sixth to North Dakota.

At the first annual corn exposition, held at Chicago, October 5 to 19, 1907, there was an intercollegiate corn-judging match, which was participated in by teams of students from the Kansas and Iowa agricultural colleges, the first prize of \$200 being awarded to the Iowa college students.

#### OTHER FEATURES OF PROGRESS.

The Colorado Agricultural College, as a result of recent Congressional action, has been given a quarter section of land for use in experiments in forestry. The State has made an appropriation for the purchase of land for the college and station, and has authorized the use of 10 per cent of the funds arising from the sale of lands under the act of 1862. The college announces a two-year practical course in agriculture, domestic science, and horseshoeing, to be open during the five winter months of each year. Successful short courses were held during the winter in horticulture, forestry, and domestic science. The short course in horticulture was held at Delta.

The Connecticut College has recently held a six-weeks' course in forestry under the directorship of the State forester, the work including the practical work of forest management, the reproduction, growth, and maturity of forest trees, destructive agencies in the forest and their control, and the care of Connecticut forests. A<sup>11</sup>

partment of forestry has been inaugurated at the University of Georgia, with Alfred Akerman in charge.

The legislature of Hawaii has passed an act providing for the establishment of a college of agriculture and mechanic arts, and appropriating \$25,000 for buildings and maintenance for two years. Willis T. Pope, of the science department of the Honolulu Normal School, has been appointed acting dean of the college and will proceed immediately with the organization of the institution on the new high-school site in Honolulu. As soon as the development of the college permits, it will be removed to its permanent site in Manoa Valley, adjoining the Mid-Pacific Institute, where a tract of about 30 acres is reserved for it.

A department of dairying has been established at the Idaho University under the direction of J. H. Frandson as professor of dairying at the university and dairyman at the station.

A proposition to establish a veterinary college at the Chicago Union Stock Yards as a department of the University of Illinois has been submitted to the trustees of the university and has met with favorable consideration. The object of this institution will be, in addition to the training of ordinary veterinary practitioners, the supplying of inspectors for the Government service. In connection with the veterinary instruction the project contemplates a completely equipped laboratory for physiological research. It is understood that the packing houses propose to contribute liberally toward the erection of buildings and the initial endowment, but that the management will rest entirely with the University of Illinois.

The Kansas Agricultural College has been designated by a recent act of the State legislature as the State highway commission, and among its duties will be the devising of plans and systems of highway construction and of regulations for the repair and maintenance of highways, the conducting of demonstrations in road building at the request of the county commissioners, the providing of trained demonstrators for this purpose, and the disseminating of information among the county commissioners, highway officials, and the general public. The department of domestic science is conducting a month's dietary study among its students. A six weeks' summer school in agriculture has been established, chiefly for teachers, and similar in scope to that now given in domestic science. The college faculty has begun the preparation of a text-book on elementary agriculture which is being issued in a series of monthly pamphlets under the supervision of the superintendent of college extension. A pamphlet on soils has already been issued and others will follow on How Plants Feed, Tree Culture, Birds and Insects, Hygienic Cookery, Live Stock on the Farm, and other related topics.

The New Mexico College has added a course in farm machinery for which considerable equipment has been provided; also a two-year course—four months each winter—in agriculture and home economics. It has materially increased the size of its live-stock herd for instruction work.

The most marked departure in the administration of the New York State College of Agriculture at Cornell University in the present college year is the dismemberment of the former department of agronomy. Director Bailey does not regard agronomy as a unit, either in respect to teaching or administration. It is no more a unit than the old departments of agriculture were, although it is somewhat narrower in its scope. Moreover, it is the purpose of the present administration at Cornell to allow each officer to devote the maximum of his time to his special subject, relieving him as far as possible of administration. Each officer is required to administer only those affairs that pertain to his particular specialty. This results in the breaking up of large departments into their separate units. In the place of a department of agronomy there are now such professorships at Cornell as farm crops, farm practice, soil, plant pathology, and plant biology (plant breeding). The subject of farm management is not yet definitely separated. This division allows each man to develop his full personality and to have the entire responsibility of his subject. In order that the organization may be compact, the men who are teaching the plant industries constitute an unofficial committee of subfaculty through which, as well as other individual officers, the director is able to assist in coordinating the work, so that the departments may have a pedagogical unity. Another innovation is the separation of the farms into a separate department. Heretofore the farms have been in charge of the department of agriculture and of its successor, the department of agronomy. The farms, however, should constitute a series of laboratories equally accessible to all departments in the college of agriculture, and as a consequence of the division of the department of agronomy no one of the separate departments would naturally be called on to manage the farms. The management of the farms is made to rest theoretically with the director's office; but they are put in charge of a professor of farm practice with whom any department in the college may equally arrange for land or other facilities. The professor of farm practice gives instruction in his subject, both by means of lectures and by laboratory work in the barns and fields. This arrangement has been established as seeming to be preferable for conditions at Cornell to the method in some institutions of giving each department a farm of its own.

As a result of an agreement with Cornell University arrangements have been made at Teachers' College of Columbia University

accept at full value for degree work credits in agriculture at any of the leading agricultural colleges. This is done with a view to fitting students for the positions of director, principal, etc., in training schools for teachers of agriculture.

The Agricultural and Mechanical College for the Colored Race, at Greensboro, N. C., has added a dairy department and a teachers' training department to prepare teachers especially for instruction in agricultural and mechanical branches. The college session has been increased by one month and a preparatory course is to be offered.

At the North Dakota College a summer school of traction engineering was held July 2 to 26 under Prof. P. S. Rose, of the engineering department. The forenoon of each day was devoted to lectures on traction engineering and the economics of thrashing. In the afternoon there were lectures on gas engineering and classes in arithmetic. The practical work consisted in running both steam and gasoline traction engines, setting valves, putting in boiler tubes, babbitting boxes, lacing belts, etc., all under the direct supervision of experts in those lines of work. Each student was given time enough at practice work to become thoroughly proficient in handling and adjusting traction engines. Considerable attention was also given to the handling of grain separators. A school of forestry was opened January 7 at Bottineau with an enrollment of 30 pupils. This is a State school, for which the legislature has appropriated \$25,000 for a building.

The Percheron Horse Society of France has voted to offer to the department of animal husbandry of the Ohio State University a trophy in bronze representing a Percheron horse, which is to be competed for annually by the students taking instruction in horse judging at the university. The student showing the greatest proficiency will have his name inscribed on the base of the trophy.

A four-year undergraduate course in forestry has been established at the Pennsylvania State College, and is now in charge of Hugh P. Baker, formerly of this Department and of the Iowa State College. A three-year course in forestry is now offered at Purdue University and a two-year course at Washington State College.

At the Utah College the courses of study have been reorganized. A college course in veterinary science has been offered for the first time, the work in agriculture has been increased, and the course divided so that now degrees are offered in agronomy, arid farming, horticulture and entomology, irrigation and drainage, and animal industry and dairying. A cooperative arrangement has been entered into with the University of Utah whereby a course in irrigation engineering will be offered jointly by the two institutions. The practical and agricultural work will be given by the college and the

technical engineering by the university. A normal course in agriculture and domestic science has been established on a similar cooperative basis.

A department of agricultural extension work and one of highway construction have been established in the College of Agriculture of the University of West Virginia and a good-roads school has been announced to open February 24, 1908, and continue four weeks. The State department of good roads, the State geological survey, and the inspector of highways will cooperate with the university in conducting this school.

Prof. W. A. Henry, for many years dean of the College of Agriculture of Wisconsin University, has retired from the deanship of the college and been appointed emeritus professor of agriculture. H. L. Russell, professor of bacteriology in the university, succeeded to the deanship. During the past summer Dean Henry conducted a class in agriculture for teachers in the public schools, and contemplates giving much of his time henceforward to the study of means for preparing teachers for this work. A department of extension in the university has been established under the direction of Prof. L. E. Reber, formerly dean of the School of Engineering of Pennsylvania State College. The extension work will consist of lectures and correspondence for all courses of study in the university, for which university credits toward graduation will be allowed, subject to a regulation prescribing a two-year minimum of resident study at the university.

In Wyoming the protracted litigation between the State University and the Lander Agricultural College as to the disposition of the Federal funds has been terminated by a decision of the United States Supreme Court sustaining the contention of the university, which will therefore continue to be the recipient. The opinion was by Justice Moody, who held that these Government grants are to the State and not to a particular institution.

### THE SECONDARY SCHOOLS.

There is a growing sentiment in all parts of the country in favor of secondary schools of agriculture to train young men for the business of farming and to fill the gap between the rural common schools and the colleges of agriculture. This sentiment is epitomized in an address made by the President of the United States at Keokuk, Iowa, last October, in which he said:

The Congressional land-grant act of 1862 accomplished much in establishing the agricultural colleges in the several States, and, therefore, in preparing to turn the system of educational training for the young into channels at once broader and more practicable—and what I am saying about agricultural train-



ing really applies to all industrial training. But the colleges can not reach the masses, and it is essential that the masses should be reached.

Such agricultural high schools as those in Minnesota and Nebraska for farm boys and girls, such technical high schools as are to be found, for instance, in both St. Louis and Washington, have by their success shown that it is entirely feasible to carry in practical fashion the fundamentals of industrial training into the realms of our secondary schools.

At present there is a gap between our primary schools in country and city and the industrial collegiate courses which must be closed, and if necessary the nation must help the State to close it. Too often our present schools tend to put altogether too great a premium upon mere literary education, and therefore to train away from the farm and the shop.

We should reverse this process. Specific training of a practical kind should be given to the boys and girls who when men and women are to make up the backbone of this nation by working in agriculture, in the mechanical industries, in arts, and trades; in short, who are to do the duty that should always come first with all of us, the duty of home making and home keeping.

Referring again to this matter at the opening of the first session of the Sixtieth Congress, the President said in his message:

Our school system is gravely defective in so far as it puts a premium upon mere literary training and tends therefore to train the boy away from the farm and the workshop. Nothing is more needed than the best type of industrial school, the school for mechanical industries in the city, the school for practically teaching agriculture in the country. The calling of the skilled tiller of the soil, the calling of the skilled mechanic, should alike be recognized as professions just as emphatically as the callings of lawyer, doctor, merchant, or clerk. The schools should recognize this fact, and it should equally be recognized in popular opinion. The young man who has the farsightedness and courage to recognize it and to get over the idea that it makes a difference whether what he earns is called salary or wages, and who refuses to enter the crowded fields of the so-called "professions" and takes to conservative industry instead is reasonably sure of an ample reward in earnings, in health, in opportunity to marry early, and to establish a home with a fair amount of freedom from worry. It should be one of our prime objects to put both the farmer and the mechanic on a higher plane of efficiency and reward, so as to increase their effectiveness in the economic world, and therefore the dignity, the remuneration, and the power of their positions in the social world.

#### **REPORT OF THE MASSACHUSETTS COMMISSION ON INDUSTRIAL EDUCATION.**

On June 21, 1906, the governor of Massachusetts approved an act of the legislature providing for the appointment of a commission on industrial education to serve for three years and empowered to investigate methods of and local needs for industrial education, to initiate and superintend the establishment and maintenance of industrial schools for boys and girls, with the cooperation and consent of the municipality or municipalities involved. The law also gave power to cities and towns, individually or collectively, to provide independent industrial schools for instruction in the principles of agriculture and the domestic and mechanic arts, fixed a scale for State reimburse-

ment for local taxation for such schools,<sup>a</sup> and authorized the trustees of the Massachusetts Agricultural College to establish a normal department for the purpose of giving instruction in the elements of agriculture to teachers.

The commission appointed under the provisions of this law consists of Paul H. Hanus, chairman; A. Lincoln Filene, Charles H. Winslow, Carlton D. Richardson, and Mrs. Mary Morton Kehew. Charles H. Morse has been chosen secretary of the commission and is its executive officer, though not a member of the commission.

In its first annual report, issued in March, 1907, the commission gives a record of its preliminary investigations, announces its provisional platform, points out the need of industrial schools—*independent schools*—to supplement the existing school system, and outlines in a general and tentative way the field to be covered by the industrial schools. The commission found a strong sentiment for the establishment of agricultural schools and announced its conclusions on this matter as follows:

It is the opinion of the commission that there is a demand in various agricultural sections for schools which shall be devoted to specialized work, object lessons and such practical courses as have a direct bearing on farm life for both boys and girls.

Furthermore, it is the belief of the commission that agriculture must be developed in Massachusetts on a plan different from the one so successfully followed in our Western States. Here our farming must be intensive, instead of extensive, as in the West. It is hoped that a typical agricultural school may be established before the next annual report.

Such a school would take the boy and girl at the age of 14. In addition to the work assigned the boy to be done on the farm, which would be under the control of the school, he would be given practice work, drawing and other studies particularly useful in farm management. The regular course should be sufficiently extended to prepare pupils for admission to the State Agricultural College at Amherst, and winter courses should be provided for those whose services could not be spared from the farm in summer.

The practice work, including the shop work, should be such as would be most helpful to a farmer, such as would result in making a man skillful in the care and repair of farm machinery and buildings. Another line of work should certainly include botany, physiology and hygiene, applied physics, chemistry, and mathematics, also surveying.

The year should be divided into three terms; and the following courses, as given in the Marathon County School of Agriculture and Domestic Economy of Wisconsin, could be modified to meet the requirements of our rural communities:

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<sup>a</sup> Cities and towns expending more than five dollars for each thousand of valuation for the support of public schools to be reimbursed by the Commonwealth to the amount of one-half, those raising and expending between four and five dollars per thousand to the amount of one-third, and those raising and expending less than four dollars per thousand to the amount of one-fifth, of the cost of maintaining industrial schools: *Provided*, That no payment to any city or town shall be made except by special appropriation by the legislature.

## COURSE OF STUDY FOR BOYS.

*First year.*

*First term.*—The soil, d. 5;<sup>a</sup> shop work, carpentry, d. 5; English, 5; business arithmetic, 5.

*Second term.*—Soils and fertilizers, d. 5; shop work, carpentry, d. 5; English, 5; library reading, 5.

*Third term.*—Plant life, d. 5; vegetable, flower and fruit gardening, d. 5; poultry, d. 5; English, 5; library reading, 2.

*Second year.*

*First term.*—Plant life, d. 5; shop work, blacksmithing, d. 5; United States history, 5; economics, d. 3; library reading, 5.

*Second term.*—Animal husbandry, d. 5; rural architecture, d. 5; United States history and civil government, 5; library reading, 5.

*Third term.*—Animal husbandry, d. 5; vegetable, flower, and fruit gardening, d. 5; economics of agriculture, 5; library reading, 5.

## COURSE OF STUDY FOR GIRLS.

*First year.*

*First term.*—Cooking and sewing, d. 5; domestic hygiene, 5; English, 5; business arithmetic, 5.

*Second term.*—Cooking and sewing, d. 5; home economy, 5; English, 5; library reading, 5.

*Third term.*—Cooking and sewing, d. 5; vegetable, flower and fruit gardening, d. 5; English, 5; library reading, 5.

*Second year.*

*First term.*—Cooking and sewing, d. 5; laundry, d. 3; United States history, 5; library reading, 5.

*Second term.*—Cooking and sewing, d. 5; chemistry of foods, 5; United States history and civil government, 5; library reading, 5.

*Third term.*—Cooking and millinery, d. 3; home nursing, d. 2; poultry, d. 3; vegetable, flower, and fruit gardening, d. 5; library reading, 5.

The city of Northampton has by vote asked the cooperation of the commission in the establishment of an agricultural school, and has appointed a committee with power to represent the city.

**AGRICULTURE IN THE NORMAL SCHOOLS.**

The Office of Experiment Stations has recently made an inquiry concerning the teaching of agriculture in the 182 State normal schools in the United States and finds that 64 of these schools are now teaching agriculture. Of these, 4 are in Alabama, 3 in California, 1 in Colorado, 2 in Connecticut, 2 in Georgia, 3 in Illinois, 1 in Iowa, 1 in Kansas, 1 in Louisiana, 3 in Maine, 3 in Michigan, 5 in Missouri, 1 in Montana, 3 in Nebraska, 1 in North Carolina, 2 in North Dakota, 1 in

<sup>a</sup> The numerals denote the number of recitation periods per week; d. denotes double period.

Ohio, 3 in Oklahoma, 1 in Oregon, 1 in South Carolina, 1 in South Dakota, 1 in Texas, 2 in Utah, 2 in Virginia, 3 in Washington, 6 in West Virginia, and 7 in Wisconsin.

The instruction in agriculture in 13 of these institutions is confined to the text-book, in 35 the text-book work is supplemented by laboratory exercises, school garden work, or other practicums, while in the remaining 16 schools the nature of the instruction is uncertain, though it is likely that fully half of these provide practice work.

In 11 of the normal schools agriculture is taught by teachers of agriculture, in 11 by teachers of science, and in the remaining 7 by other teachers—principals, teachers of pedagogy, economics, etc. Fully 70 per cent of all the teachers of agriculture in normal schools were trained for other lines of work, and of the remaining 30 per cent nearly one-half are burdened with other science work. And yet this is a better showing than one would expect in a movement of such recent origin in the United States.

The normal schools of Missouri have been longer in the field, and, all things considered, are probably better equipped for teaching agriculture than those of any other State. The school at Springfield is less than 2 years old and has not yet succeeded in getting its agricultural department fully organized, but the other four schools employ teachers of agriculture and provide liberally for laboratory work and other practicums. At Cape Girardeau agriculture occupies a full year, and at Columbia a year's instruction by the regular teacher of agriculture is supplemented by lectures and practicums conducted by teachers of agriculture from the State university. At Kirksville there are two years of agriculture in the undergraduate course and one year in the graduate course, and this work is supplemented by laboratory, school garden, and field work and by assigned readings and discussions. At Warrensburg agriculture is offered in one course during two terms of the freshman year, in two other courses during two terms of the sophomore year, and in graduate work. Laboratory work covers every part of the course.

In the State Normal School at Jacksonville, Ala., agriculture is taught in the first and second years and horticulture in the fourth year. In a small experimental and botanical garden the students are taught pruning, grafting, budding, layering, and floriculture. "Throughout the entire curriculum agriculture is taught in its relation to the other sciences."

The State Normal School at Greeley, Colo., requires agriculture four hours a week throughout the eleventh grade of the high-school course and the ninth grade of the normal-school course, and offers it as an elective in the twelfth grade of the high-school course. It is taught by the associate professor of nature study, school gardening, and elementary agriculture.

Georgia maintains two normal schools which are effective in their work in agriculture. At Milledgeville agriculture is a required subject in the freshman year and is followed in the junior and senior years by special courses in the study of plants, animals, climate, weather, soils, etc. At Athens agriculture is one of the subjects in the review courses for teachers unable to take the full diploma course. It is also taught throughout the diploma course. In the senior year students recite one double period a week on elementary agriculture, which includes a review of previous work and a study of methods. The school is equipped with a 20-acre farm which furnishes the dining hall with vegetables, milk, and pork, and is utilized as a laboratory for the classes in agriculture.

In the normal school at Rockhill, S. C., agriculture has been taught for seven years, largely in connection with a propagating house and school gardens. Recently an agricultural college graduate has been put in charge of the work, and courses in horticulture, floriculture, and dairying have been added.

The examples cited are fairly representative of the work of the better normal schools offering text-book work in agriculture supplemented by laboratory and field practicums, but no account of the work of the normal schools would be quite fair without mention of the fact that many of those which make no pretense of teaching agriculture are really giving more effective instruction in the principles and practice of the farmer's vocation than are some of the schools which mention agriculture in their catalogues. The writer has in mind one normal school in New England where the students get thorough and practical instruction in plant production, from selecting the seed to harvesting and marketing the crop, banking the proceeds, and checking out the money to pay expenses. This work is closely correlated with reading, spelling, composition, arithmetic, geography, drawing, manual training, and civics. It is called "nature study and school gardening," but it is much more than that; it is broad, liberal training in the business of life, and that is what agriculture in the public schools should be for the farm boy.

Some mention should also be made of the efforts of school authorities in Michigan, Nebraska, New York, Wisconsin, and perhaps other States to prepare teachers of agriculture in county normal training schools. These are village or city high schools in which during one or two years the rural subjects are reviewed and some practice in teaching them is afforded. All of the schools of this class in the States mentioned above are supposed to teach elementary agriculture, but the time available is so short that little more than text-book work has been attempted thus far. In Nebraska, however, the State superintendent of public instruction has recently issued a pamphlet show-

ing in considerable detail the work he desires to have undertaken in agriculture. This work extends over one full year and includes the following subjects: Farm animals, 32 class periods, and 8 double laboratory periods; milk and its products, 20 class periods, and 5 double laboratory periods; soils, 24 class periods and 11 double laboratory periods; field crops, 18 class periods and 12 double laboratory periods; orchard and garden crops, 18 class periods and 12 double laboratory periods. The pamphlet also gives a list of articles needed in the equipment of a laboratory and of books for the agricultural library.



FIG. 22.—Main building of the Guthrie County High School, Panora, Iowa.

#### A COUNTY HIGH SCHOOL.

The Guthrie County High School, Panora, Iowa, is rendering good service to the rural people of the county and is in a position to increase its usefulness greatly with the development of plans now under consideration for strengthening its agricultural work. The school was established in 1877, and for several years occupied an old wooden court-house on the village square. Later this building was removed and a two-story and basement brick building was erected. The school soon outgrew this building, and in 1897 it was superseded by a fine modern brick structure with conveniently arranged, well-lighted rooms, heated and ventilated by an indirect system of radiation, which cost, with equipment, \$22,000. (Fig. 22.) The older brick building

is now used mainly for the work in science and agriculture—recitations and laboratory work.

The school costs the taxpayers of the county about \$6,000 or \$7,000 a year. Students up to a certain percentage of the population of each township are admitted to the school free of tuition, but in case any township has more than its quota of students the township must pay their tuition.

The faculty of the school consists of the principal and seven assistants, one of whom is teacher of agriculture. There are now about 200 students enrolled and all of them are in high-school grades. Fifty students are enrolled in agriculture.

Three courses of study are offered—a Latin course, a science course, and an agricultural course. These courses are much alike except that in the two latter Latin is replaced by science and agriculture. The agricultural course, which has been developed during the past three years, is as follows:

*First year, all courses alike.*—Arithmetic, algebra, American history, civics, physiology, Latin, and English.

*Second year.*—Algebra, English; ancient, medieval, and modern history; agronomy; animal husbandry; feeds and feeding, and bookkeeping.

*Third year.*—Algebra, one-half year; plane geometry, one-half year; German, physics, geology, and farm mechanics.

*Fourth year.*—Plane and solid geometry, German, political economy, one-half year; English, one-half year; chemistry, soils, and horticulture, one-half year.

Plans are under discussion to distribute better the agricultural work by introducing agronomy into the first year. The work in agronomy as it is now arranged includes the study of corn and other grains during the winter months when it is impossible to do field work; a study of soils, including plant food, sources of fertility, texture, moisture and the causes affecting its movement and conservation, and similar topics which are investigated in the laboratory, each student gathering and testing his own samples. There is some equipment for soil-laboratory work, including a drying oven, soil tubes, etc.

In animal husbandry horses, swine, and both beef and dairy types of cattle are studied. Craig's Stock Judging is used as a text-book, but is supplemented by lectures on the origin and history of the various breeds of live stock and score-card practice. For this work the classes visit stock farms in the vicinity of the school. (Fig. 23.)

The second semester of the senior year is devoted to horticulture, using Goff's Principles of Plant Culture, and Bailey's The Nursery.

The work in farm mechanics has been introduced this year for the first time and consists largely in a study of farm machinery with practicums in assembling some of the most important machines. At



the present time the school is provided with two gasoline engines, a mowing machine, a corn harvester, and a manure spreader, which have been loaned by the manufacturers.

The teacher of agriculture, Mr. J. I. Thompson, was a third-year student at the Iowa State College when compelled to drop out of school on account of illness. He expects to complete this year at the Panora school and then return to college for the remainder of his course.

#### THE WINONA AGRICULTURAL INSTITUTE.

The school which was organized in 1902 at Winona Lake, Ind., as the Winona Agricultural and Technical Institute, was reorganized in



FIG. 23.—Students of Guthrie County High School scoring a beef steer at a neighboring farm.

1906 as a purely agricultural school. Formerly the course of study extended over six years and included the so-called cultural as well as the vocational subjects, now it takes two years to complete the course and the only subject not closely related to agriculture is Bible study. The instruction is given in three departments, (1) agriculture and chemistry, (2) dairying and animal husbandry, and (3) horticulture and forestry. The following statements concerning the school are taken from an article in the *Cornell Countryman* for Feb-



ruary, by W. C. Palmer, professor of agriculture and agricultural chemistry in the school:

In the first year the following subjects are taken up, the figures referring to the number of recitations and laboratory periods: Agricultural Chemistry, 168; Soils, 48; Breeds of Live Stock, 84; Poultry, 36; Agricultural Botany, 36; Dairying, 36; Farm Crops, 60; Economic Entomology, 36; Vegetable Gardening, 36; Climatology, 12; Farm accounts, 24; Bible, 72. Second year's work, Agricultural Chemistry, 36; Forestry, 48; Dairying, 72; Farm Engineering, 26; Farm Law, 36; Feeds, 60; Fruit Growing, 92; Agricultural Physics, 48; Breeding, 24; Farm Economics, 48; Farm Management, 24; Veterinary Physiology, 48; Stock Judging, 36; Bacteriology, 24; Parliamentary Practice, 12; Bible, 72.

The instruction is given through class-room recitations, laboratory and field work, and field trips. Laboratory and field work are given in all subjects that can be taught in that way. In agricultural chemistry two recitations and three laboratory periods are given per week. In the study of breeds of live stock, the classes have a good many recitations at the barns, using the school herd for demonstration work, and frequent trips are made also to nearby stock farms. In studying soils, laboratory work is given in soil physics and trips are also made to the fields, hills, and lowlands to study the soils in relation to plant growth. In the study of poultry, incubators and brooders and their workings are studied as well as the breeds of poultry, feeding and management; trips are also made to nearby poultry farms. In dairying the work is nearly all in the laboratory, the students getting practice in the operating of different makes of separators, in milk and cream testing, in cream ripening, in butter making, packing and marketing. In entomology most of the work is done in the orchard, garden, and field, studying the insects at work. In vegetable gardening each student has to plant and care for a 30 by 60 foot garden in addition to class-room recitations. In forestry about half the time is given to study and work in the woods and in visiting commercial forests. In farm engineering most of the time is given to drainage problems, surveying, taking levels, establishing grades, and finally laying the tile and estimating the cost of the whole operation. In agricultural physics a study is made of barn and silo construction, machinery, engines, concrete work, etc.

Whenever possible, trips are made to nearby farms, orchards, gardens, and dairies in addition to the practical work that can be given with the school's equipment, the better to familiarize the students with the actual practical farm problems and to get them to really use their agricultural science. The school has a set of grass and clover plats where some twenty-five of the best clovers and grasses are grown. On another set of plats some fifty of the different agricultural crops are grown. A set of rotation plats are maintained to show the value of rotating crops. The value of different combinations of fertilizers and manures is being determined with corn, potatoes, and soy beans. Variety tests are carried on with corn, cowpeas, soy beans, oats, and barley. A set of plats has been set aside for a weed garden where the different weeds of the country will be grown so that the student can study them first hand. These plats are especially valuable in the study of farm crops, botany, and farm management.

#### GEORGIA AGRICULTURAL SCHOOLS.

Progress has been made in each of the eleven Congressional districts in Georgia in the construction of buildings and the organization of

faculties for the district industrial and agricultural schools. Plans for the buildings were drawn by an architect employed by the State, so that the same style of architecture prevails in all of the schools. The buildings are substantial brick structures with concrete foundations and are two stories in height. (Fig. 24.)

Several of the schools have planned to open early in January, 1908, while others will delay until September. The courses in agriculture, horticulture, and forestry outlined by the Expert in Agricultural Education of this Office were adopted at the meeting of representatives from the different boards of trustees in Atlanta, May 23, 1907.



FIG. 24.—New buildings of the Second District Agricultural School, Tifton, Ga.

These courses, substantially as adopted, were published in *Progress in Agricultural Education*, 1906.

#### CECIL COUNTY AGRICULTURAL SCHOOL, CALVERT, MD.

In the last report of this Office an account of the establishment of this school and an outline of its course of study were given. This course of study was followed but did not set the boundaries of the work of the school or of its principal. The pupils participated in several well-attended public educational meetings, contributed frequent articles on the work of the school to the county papers, took part in a farmers' institute and corn-judging contest, helped to reno-

vate and spray an old orchard (fig. 25), and made several trips to neighboring farms to study live stock (fig. 26), field crops, soils, etc. The principal, in addition to his regular work, visited the elementary



FIG. 25.—Students spraying an old orchard.

schools within a radius of 4 or 5 miles from Calvert, giving talks on nature study and elementary agriculture, and helping the teachers to start work along these lines, and in the spring months conducted night



FIG. 26.—Students of Cecil County (Md.) Agricultural School studying Yorkshire swine.

school for the large boys who were compelled to drop out of day school to assist in farm work. Practically all of these boys attended night

school regularly, and at the close of the year passed the examinations given to the other students.

The school won the approval of the community almost immediately. Within four months after it opened plans for a permanent school were set in motion, with the result that the county board of commissioners appropriated \$5,000 for a high school building at Calvert. Plans for this building were drawn and submitted for bids and a site was donated, but it was found that the appropriation would not cover the cost of the structure planned. Building operations have therefore been postponed until more money can be raised.

The present school year started with the same principal in charge (though it was necessary to increase his salary nearly 100 per cent) and with an enrollment almost as large as the total enrollment last year. There were 21 students in the second year class, 13 in the first year, and 17 in the preparatory year.

#### **AGRICULTURE AT THE WATERFORD (PA.) HIGH SCHOOL.**

In *Progress in Agricultural Education*, 1905, attention was called to the successful teaching of agriculture in the high school at Waterford, Pa., a village of about 700 inhabitants. It is gratifying to note that this work has been continued successfully up to the present time, and that several new features of instruction have been introduced.

From an article in a recent number of the *Cornell Countryman*, written by Mr. H. F. Button, teacher of agriculture at Waterford, we learn that the popularity of the course in agriculture is fully attested by the fact that 95 per cent of the boys now take the agricultural work. The parents of these boys and the local grange give unqualified support to the course in agriculture. This work is given throughout the entire four years, one period each day, and while the school has had no live stock of its own, and very little land which the pupils could use, it has made use constantly of the live stock and field crops belonging to the patrons of the school for illustrative purposes. Recently a public-spirited citizen has donated the use of 3 acres of excellent farming land near the school, which will be used for experiments in crop growing. A part of this land is covered by an uncultivated orchard, which will be renovated by the students.

The school has a small laboratory containing some simple apparatus, to which has been added recently an eight-bottle Babcock tester, which is used not only in laboratory practice in milk testing, but also in testing samples of milk sent in by parents, cheese makers, and others.

Much emphasis is placed upon composition work relating to the agricultural instruction and upon supplementary reading. Tables in the class room are supplied with all the principal agricultural papers



and bulletins from the United States Department of Agriculture, which are reviewed by the students and freely used in the class room.

In closing his article concerning the work of the school Mr. Button makes the following very encouraging statement:

One of the most satisfactory features of the work is the pleasant and sympathetic relationship which it establishes between teacher and parent. The parents send their farm problems to school, feeling that it is a part of, and not alien to, their farm life. The school has become an essential part of the social life of the community, sharing with church and grange in providing a meeting place for town and country on a ground of common interest.

Here at least the success of agricultural teaching is assured. Although many details of "what and how" are yet to be settled, the main facts remain; that here, at least, agriculture is successfully taught in the high school, that it has pedagogic value similar and equal to any of the natural sciences, and, finally, that it does fit boys and girls for better and broader life in the country.

#### **AGRICULTURAL HIGH SCHOOLS RECENTLY ESTABLISHED.**

The first county school of agriculture and domestic economy organized under the Michigan law of 1907 was opened at Menominee, November 18, 1907. A two-year course of study recommended by the State superintendent of public instruction will be followed. J. F. Wojta, formerly of the Minnesota School of Agriculture, is superintendent of the school.

A new county school of agriculture and domestic economy was opened at Winneconne, Wis., November 4, 1907. K. L. Hatch, formerly superintendent of schools at Waterloo, Wis., has been elected principal and teacher of agriculture. The courses in agriculture and domestic economy will be very similar to those offered by the schools in Dunn and Marathon counties.

In California \$132,000 was appropriated by the State legislature for the equipment of a new farm at Davisville, and the establishment of an agricultural high school on its grounds. A dairy building, stock pavilion, and two cottages have been erected, and a short course announced to be held in January, 1908. Dr. Leroy Anderson, director of the California Polytechnic School at San Luis Obispo, has been elected professor of practical agriculture at the University of California, and director of farm schools, which include the farm school at Davisville and one at Fresno.

#### **THE PRIMARY SCHOOLS.**

Much is said of the recent movement for agriculture in the public schools, which would lead one to believe that all of the agitation, discussion, and experimenting along this line had occurred during the past dozen or fifteen years. During the year just closed several in-

teresting sidelights have been thrown upon the movement which indicate for it a much earlier origin in this country.

In an address made before the Society for the Promotion of Agricultural Science, the Director of this Office brought out the fact that the first attempt to introduce agriculture into the elementary schools was through reading books, the earliest of which was "The Agricultural Reader Designed for the Use of Schools," by Daniel Adams, M. D., Boston, 1824. In the introduction the author quotes Doctor Apthorp to the effect that "Agriculture and the Gospel are the two great instruments of Divine Providence to check the voluptuousness and exercise the virtues of man." The book opens with definitions of seventy-nine terms which are to be memorized, then follow about seventy agricultural articles chiefly on agricultural practice. Chief attention is given to field crops and their culture, a few horticultural topics are discussed, and there is one chapter "On the importance of procuring a good breed of cows." There are also chapters on lightning rods; dram drinking; brief hints to parents; the way to make money plenty in every man's pocket; and the mode of making and refining cider, adopted by the religious society called Quakers; together with poems on rural felicity and female felicity.

This book was followed by several others and by some definite, organized efforts to introduce the instruction of agriculture into public schools. From an article in the fifty-fourth annual report of the secretary of the State board of agriculture, by F. H. Fowler, on "Early agricultural education in Massachusetts," we learn that the movement for the teaching of agriculture in the public schools of that State dates back nearly fifty-six years. At the third meeting of the State board of agriculture in September, 1852, a committee was appointed to consider the expediency of preparing a manual on agriculture for the use of common schools. The following statements concerning the subsequent actions of this board are taken from Mr. Fowler's article:

At the succeeding annual meeting of the board in January, 1853, this committee submitted the following report, which was accepted:

The committee who were instructed to consider the expediency of introducing into our public schools the study of the elements of agricultural science, report:

That studies of this description might be attended to with much benefit under competent teachers. The surprise is that they have been omitted so long, while so many of less practical utility have been introduced.

Probably the want of text-books adapted to the understandings of pupils has been one cause of this.

The committee have examined *The Progressive Farmer*, by Professor Nash, of Amherst, and think it better adapted to the wants of the community than any work of the kind that has come to our knowledge.

In 1856 a committee was appointed to consider the propriety of having a text-book of agriculture prepared under the sanction of the board, and at the annual meeting of the board in 1860 the committee on agricultural education was authorized to prepare "an elementary manual on agriculture for the use of our common schools." The committee was also requested to cause this manual,

when approved by the board, to be introduced into the common schools of Massachusetts, and was authorized to apply to the legislature for the passage of an act to accomplish this object.

At the meeting of the board on January 10, 1861, it was—

*Voted*, That the committee on the manual be authorized to accept a proposition from Mr. Emerson and Mr. Flint, securing to them the copyright of the manual as a compensation for their services in preparing the book, upon such terms as to price of the work to be furnished to public schools, farmers' clubs, and agricultural associations in Massachusetts as may be agreed upon by said committee.

At the meeting of the board, January 25, Col. Marshall P. Wilder presented the following report, which was accepted and the agreement confirmed:

The committee appointed by the board to negotiate with the authors of the Manual of Agriculture for the copyright of the same, report that they have attended to that duty and submit the following agreement as the result of their labors:

BOSTON, January 2, 1861.

The undersigned agree to furnish the manuscript for a Manual of Agriculture for the use of the schools on the following terms:

The cost of composition, electrotyping, and illustrating of the manual shall be paid by the board of agriculture of Massachusetts.

The copyright and plates of the manual shall be held by the undersigned, under an agreement that the book shall be furnished by them to the schools, agricultural clubs, State board of agriculture, and other agricultural associations of Massachusetts at a price only sufficient to cover cost, interest, and commission.

(Signed)

GEO. B. EMERSON,  
CHAS. L. FLINT.

The following resolution was unanimously adopted:

*Resolved*, That this board approve of the Manual of Agriculture submitted by its authors, George B. Emerson and Charles L. Flint, and recommend its publication by those gentlemen as a work well adapted for use in the schools of Massachusetts.

At a meeting of the board, held January 17, 1862, it was—

*Resolved*, That a committee of three, consisting of Messrs. Joseph White, Charles C. Sewall, and Henry H. Peters, be requested to represent the merits of the Manual of Agriculture to the committee of the legislature on education, on the order "To consider the expediency of including the elements of agriculture among the branches to be taught in all the public schools in which the school committee deem it expedient."

Meanwhile in the house of representatives on January 16, 1862, Mr. Sewall of Medford offered an order calling upon the standing committee on education to consider the expediency of including the elements of agriculture among the branches to be taught in all the public schools in which the school committee deem it expedient. A bill subsequently reported by this committee was enacted as chapter 7 of the act of 1862 as "an act concerning the public schools," which provided that "agriculture shall be taught by lectures or otherwise in all the public schools in which the school committee deem it expedient."

Apparently this is one of the earliest State enactments to encourage the teaching of agriculture in all the public schools.

**BARON DE HIRSCH AGRICULTURAL SCHOOL, WOODBINE, N. J.**

This school is located in the northern part of Cape May County, N. J., on sandy plains covered with small oak and scrub pine trees. It is in a region largely taken up by Hebrews, many of whom settled there as beneficiaries of a Hebrew colonization scheme financed by the Baron de Hirsch fund for the amelioration of the condition of Jewish immigrants. The school is also supported by the Baron de Hirsch fund and is intended for Jewish young men. It is a practical agricultural school of elementary grade intended to train young men to become intelligent farm laborers, managers, and eventually to take up farming for themselves.

To be admitted to the school a young man must be able to speak, read, and write the English language and perform the fundamental operations of arithmetic. The course of study extends over two



FIG. 27.—Student spraying potatoes, Baron de Hirsch School.

years. The school year begins April 1 and is divided into three terms. The spring and summer term extends from April 1 to October 1, the fall term from October 1 to December 17, and the winter term from December 17 to March 15. During the spring and summer term the students spend seven hours a day in the practical work of the farm and garden and one hour a day in classes in agriculture, dairying, and horticulture. First-year students are given individual gardens of about one-tenth acre each, to be worked and cared for by them during the entire school year. The produce raised on these gardens is purchased from the students at market prices and paid for in cash. These first-year students spend a part of their time in general farming, for which work during the spring and summer months they are paid at the rate of \$8 to \$10 a month.

The second-year students also take part in the general farm work, driving teams, operating machinery (fig. 27), and performing all of the operations of a well-equipped, well-directed farm. Most of the



time they are under the direction of instructors, but during examination weeks they are placed almost entirely upon their own responsibility and are marked on the amount and quality of work done.

The fall and winter months are devoted largely to class work. First-year students in the fall have English, arithmetic, United States history, geography, plant life, and laboratory work daily; in the winter English, arithmetic, physiology, elementary and general physics, elementary and general chemistry, plant life, road making, and laboratory work. Second-year students in the fall term have classroom and laboratory work in stock judging, forage crops, soil physics, plant life, fruit judging, civics, poultry husbandry, feeds and feeding, dairying, and veterinary science; in the winter term the principles of animal breeding, principles of plant breeding, soil fertility, general horticulture, feeds and feeding, veterinary science, bookkeeping, and farm machinery.



FIG. 28.—General view of buildings, Baron de Hirsch Agricultural School, Woodbine, N. J. Reading from left to right: Main building; barns; dormitory; dining hall; dairy barn.

The school has a fairly good equipment throughout. The farm consists of 150 acres, several acres of which are devoted to the students' gardens, 30 acres to orchards, and smaller areas to vineyards and strawberries. There are several good teams of horses, a dairy herd housed in an up-to-date \$4,000 dairy barn, a poultry department equipped with incubators, brooders, and other modern appliances, a dairy laboratory, chemical laboratory, farm mechanics laboratory, and an apiary of 60 hives. The buildings include a brick school building containing laboratories and class rooms, a dormitory, a dining hall, a residence for the superintendent, horse barn, dairy barn, poultry houses, and other minor structures (fig. 28).

#### DEVELOPMENTS OF THE PAST YEAR.

There are many evidences of a sustained and growing interest in teaching nature study and the elements of agriculture in the primary

schools. The National Education Association at its convention in Los Angeles authorized the formation of a department of rural and agricultural education and arranged for the organization of such a department at the meeting of its department of superintendence in Washington, D. C., in February. Just at the close of the year, in Chicago, there was organized the American Nature Study Society, which has a standing committee on nature study and elementary agriculture and proposes to give much attention to these subjects not only at its meetings, but also through the official journal of the association, the *Nature Study Review*.

The legislature of Texas passed a law requiring that agriculture be taught in all schools of the State having an enrollment of less than 500. The agricultural colleges, State normal schools, some private and denominational colleges and many county normal schools, as noted elsewhere, are making efforts to provide training in agriculture for teachers in primary schools; State and county superintendents of public schools are striving to supplement this normal instruction by securing lecturers on agriculture for the teachers' institutes; and the teachers themselves are discussing the subject at their association meetings, and writing to this Department and to the State agricultural colleges and experiment stations for publications which will aid them in preparing to teach agriculture.

The extension department of the Iowa State College has added to its staff an officer who devotes his whole time to the public schools.

At the last session of Congress an appropriation of \$1,000 was made for the purpose of continuing and extending the school-garden work which has been carried on for a number of years in a cooperative way by the public schools of Washington and this Department. Beginning four years ago with a few gardens on the Department grounds and a little improvement work around a single school, the movement has grown until this year 700 children have gardens on the Department grounds, 124 school buildings in the District have gardens, and 160,000 packets of seeds have been sold for home gardens.

The educational department of the international committee of Young Men's Christian Associations has entered upon a campaign to encourage the associations in different parts of the country to start boys' agricultural clubs and boys' gardens as means of employing profitably the time of the younger members when pleasant weather out of doors attracts them away from the association rooms. A leaflet has been published giving suggestions for organizing the clubs and conducting the gardens.

The preparation of literature to aid teachers in their work along these lines is engaging the attention of many writers, especially members of agricultural extension departments in the agricultural colleges. This is true in Georgia, Kansas, New York, and Ohio, while

from several other States occasional contributions to such literature have come. The following statements concerning a few of these publications will indicate the nature of the work being done:

### TEXT-BOOKS AND WORKS OF REFERENCE.

Among the text-books, manuals, and other works of reference received at the Office of Experiment Stations during the past year the following are worthy of note:

**Cyclopedia of American Agriculture.** By L. H. Bailey et al.

Two volumes have been received of a contemplated series of four volumes on American agriculture.

**The Book of Alfalfa.** By F. D. Coburn.

This is a treatise on alfalfa, discussing the history, cultivation, and merits of the crop and pointing out its uses as forage and fertilizer.

**Bean Culture.** By G. C. Sevey.

This is a book of 130 pages devoted to the history, botany, culture, and uses of beans.

**Useful Birds and Their Protection.** By E. H. Forbush.

This is a volume of over 450 pages published by the Massachusetts board of agriculture and devoted to the general habits of birds and their protection. The subjects discussed in the volume include the general value of birds to man, their utility in orchards, woodlands, fields, and gardens, the natural checks which tend to diminish the multiplication of birds, and practical methods for the protection of useful birds.

**The A B C of Corn Culture.** By P. G. Holden.

A popular treatise on corn culture, discussing briefly soil preparation, cultivation, preparation of seed corn, combating corn pests, harvesting, and storing seed, selection and judging of corn, and the importance of the crop.

**Dairy Farming.** By J. Michels.

This is a book dealing with the essential facts relating to the science and practice of dairy farming, and is intended for the use of both the dairy student and the farmer.

**Essentials of Milk Hygiene.** By C. O. Jensen, Translated and Amplified by L. Pearson.

This book covers quite fully the whole subjects of the sanitary supervision, production, and handling of milk, and through the additions made by the translator it has been well adapted to American conditions.

**Bookkeeping for Farmers.** By T. C. Atkeson.

In this volume a comprehensive system of keeping accounts is supplemented by a practical outline of the Stockbridge system in the belief that the two methods will enable the farmer to know at any time "how the business of the whole farm or any part of it stands."

**Types and Breeds of Farm Animals.** By C. S. Plumb.

This is an illustrated volume of 573 pages, designed for the needs of live-stock students. It gives attention to breeds of horses, asses, mules, cattle, sheep, goats, and pigs, and constitutes an important summary of available data which

will be valuable to students of agriculture and also readers interested in the subject of farm animals.

**Farm Management.** By F. W. Card.

This book is an outgrowth of a course of lectures to students of the Rhode Island College of Agriculture on the problems of the farm, the aim being to awaken interest and suggest methods of studying these problems rather than to present solutions of them.

**The Healthful Farm House.** By Helen Dodd.

On the basis of experience the author discusses the arrangement and care of rooms in the farmhouse with a view to securing greater comfort and lessening the work. Suggestions are also made concerning plumbing, furnishing, and related questions.

**Food and Nutrition.** By Isabel Bevier and Susannah Usher.

This is a small volume of 45 pages, designed primarily for the use of students, and includes a number of experiments for laboratory instruction on protein, fats, carbohydrates, meat, milk, and other foods, and on the digestion of proteids and starches.

**Elements of the Science of Nutrition.** By G. Lusk.

This is a volume of 326 pages, in which the author has reviewed the scientific data upon which rests the knowledge of nutrition in both health and disease. Clear and concise summaries are given of the theories of nutrition and numerous citations are made from literature on the subjects treated.

**Forest Mensuration.** By H. S. Graves.

This is a volume of about 470 pages, designed as a text-book for the use of students in forestry and as a reference book for practical foresters and lumbermen. It gives detailed directions for scaling and measuring timber, log rules, citations from legislation, etc.

**The Garden Book of Colorado.** By Belle S. Angier.

A book devoted largely to the use of trees, shrubs, vines, and flowers for the beautifying of home grounds.

**Nature Studies on the Farm. Soils and Plants.** By C. A. Keffer.

This book contains a series of reading lessons for children, dealing in a simple and popular way with soils and their relation to plant life, the relation of the forest to the soil, weeds, buds and seeds, and other related topics.

**First Lessons in Poultry Keeping.** By J. H. Robinson.

A second-year course for the home student of poultry keeping.

**Soils; How to Handle and Improve Them.** By S. W. Fletcher.

This is a volume of over 460 pages setting forth important facts about the soil in a plain and untechnical manner. Different chapters treat of soil builders; the nature of soils; the kinds of soils and how to manage them; soil water, the benefits of tillage; the objects and methods of plowing; harrowing and cultivating; rolling, planking, and hoeing; the drainage of farm soils; farm irrigation; maintaining the fertility of the soil; green manuring and worn-out soils; farm manures, and commercial fertilizers.

**Principles of Breeding.** By E. Davenport.

This is "a treatise on thremmatology or the principles and practices involved in the economic improvement of domesticated animals and plants" prepared for

the student of agriculture in the college and experiment station and the practical breeder upon the farm. It deals first with variation, its causes, both internal and external, then with transmission as affected by external influences, heredity, and prepotency, and finally with practical problems in plant breeding and animal breeding.

**Nebraska Corn Book.** By E. C. Bishop, Deputy State Superintendent of Public Instruction.

This is a manual prepared for the boys and girls of Nebraska taking part in the corn-growing and cooking contest of 1907. It gives directions for contestants and exhibitors, and information concerning the history of corn, its use as food, its structure and composition, the selection and testing of seed corn, the growing of corn, and rules for judging corn exhibits. Less detailed information is given for wheat, oats, rye, barley, rice, potatoes, and sugar beets. For exhibitors in the domestic science work there are directions for the preparation of exhibits, recipes for cooking and canning, and some instructions in needlework.

**Corn Cultivation.** By V. Keyser, of the Nebraska School of Agriculture.

This is a pamphlet of 7 pages prepared for the instruction of boys entering the Nebraska corn contest.

**Corn, Cotton, and Chicken Contest for Georgia Schools and School Children.**

This is a bulletin published by the University of Georgia containing announcements concerning the boys' and girls' contests for 1907 and suggestions for the study of corn, cotton, and poultry. Score cards for judging each of these products are included.

**Practical Experiments with Milk and Butter.** By J. W. Decker, of the Ohio State University.

This bulletin contains ten experiments suitable for use in elementary schools. These illustrate the presence of water, organic matter, and mineral matter in milk, the separation of curd and whey, the presence of albumin and milk sugar in whey, the separation of butter fat from cream, the presence of casein in butter, tests to distinguish between butter and oleomargarine, and the effect of heat and cold on the keeping quality of milk.

**Tillage and Cultivation.** By A. G. McCall, of the Ohio State University.

This is a pamphlet of 12 pages containing a lesson in elementary agriculture with suggestions for a number of experiments with soils.

**The Soil and its Relation to Plants.** By B. M. Davis.

This is Teachers' Bulletin No. 1 of the department of natural history and elementary agriculture, Ohio State Normal College, Miami University, Oxford, Ohio. The exercises outlined represent work that has actually been done by pupils of the sixth to eighth grades. The bulletin is intended as an aid to teachers in introducing elementary agriculture into their schools, and includes 21 experimental studies relating to the root systems of plants, water in soils, soil formation, kinds or types of soils, some of the physical characteristics of soils, and the relation of soils under different conditions to plant growth. Lists of reference books and pamphlets and apparatus required for the work outlined, as well as means for keeping plants alive during cold weather, are appended.

# THE FARMERS' INSTITUTES IN THE UNITED STATES, 1907.

By JOHN HAMILTON,

*Farmers' Institute Specialist, Office of Experiment Stations.*

Farmers' institutes were held during 1906-7 in all of the States excepting Nevada and Texas, and in all of the Territories excepting Alaska and Porto Rico. The States of Florida and Washington, reported in 1906 as having suspended their institutes for lack of funds, have both been granted appropriations by their legislatures and will reopen their institute work next year. New Mexico, which had also failed in securing an appropriation last year, again made application to the legislature of 1907 for support, but was denied. Notwithstanding this failure to get Government assistance, the institutes were maintained in 1906-7 by the agricultural college and the agricultural experiment station, and funds have been set apart for carrying on the work during the season of 1907-8. The State government of Arkansas has for the first time recognized the institute work by making an appropriation of \$3,000 to the agricultural experiment station for institute expenses for the biennial period ending June 30, 1909.

## INSTITUTE STATISTICS.

Of the 45 States and Territories reporting, 44 give the total attendance at all of their institutes at 1,596,877, which is an increase over the number reported in 1906 of 297,705. The number of institutes reported in 1907 was 3,927, as against 3,521 in 1906, a gain of 406. The number of one-day institutes as given in the reports was 2,063, or 35 less than in 1906; the two-day institutes in 1907 numbered 1,784, or 473 more than in the previous year; the three-day institutes in 1907 were 80, as against 112 in 1906. The number of sessions of institutes held in 45 States and Territories in 1907 was 11,514, a gain of 105 over 1906. The average attendance in 1907 at each session was 138.8, an increase per session of 24.8 over the average of 1906.

The appropriations for institute work in the States reporting for 1907 aggregated \$284,450.67, an increase over the appropriations of 1906 of \$14,778.29, or, comparing States only that have reported for both years, the increase would amount to \$15,811.29. The appropriations for the year 1908 as reported by 42 States aggregate \$285,076.89.

If the States not reporting appropriations for 1908 receive sums equal to their expenditures for institutes during the past year, there will be added \$21,512.05, making a total for 1908 of \$306,588.94, or an increase of \$22,138.27 over 1907.

### FORMS OF ACTIVITY.

Eighteen States are reported as having held round-up institutes. The total number of sessions is given at 154, and the attendance at 30,244. Fourteen States reported 125 independent institutes, with an attendance of 46,600. Five States ran railroad specials. The attendance is given for but four and amounted to 40,705. Five States held normal institutes with an attendance of 3,775. Two States held several sessions of field demonstration work, with an aggregate attendance of 1,000. Another has reported normal meetings for instruction and special fruit growers' and dairymen's institutes held at various times, with an aggregate attendance of 10,000. Special institutes and picnics were held in another State at which State lecturers were present and gave instruction, with a total attendance of 15,000. An agricultural Chautauqua was held in one State, continuing through ten sessions, with an attendance of 2,125. Eleven States held women's institutes, ten of them reporting 713 sessions. Eight States reported 363 sessions of boys' and girls' institutes; and one, a summer school for farmers, held in 1906 for seven days, with an attendance of 405, at which ten to twelve hours' instruction was given each day. In Kansas 2,794 boys engaged in corn contests in 40 counties, 250 girls were listed in contests in the growing of flowers, and 150 in contests in home gardening. In Indiana eight summer institutes were held specially for farmers' wives and children, and in Illinois 60 out of 102 counties were represented at the winter (two weeks) short course at the university at Champaign by winners in corn-judging and bread-judging contests.

The total number of persons reached during the year exclusive of the women's institutes, the boys' and girls' institutes, and judging contests and schools is 1,746,326, an advance over the previous year of 120,904. The teaching force actually employed by the State institute directors was 1,084. Of these, 386 were from the agricultural colleges and experiment stations, who contributed 3,556 days of time. This is an increase in the number of lecturers supplied by the colleges and stations of 44 over last year and of 435 days of service.

Records showing the training of 1,287 farmers' institute lecturers are now on file in the office of the Farmers' Institute Specialist, together with the topics which they severally discuss. An analysis of these records shows that 605 hold university or college degrees; of those who have been in college but have not graduated, 21 attended

college classes one year, 49 two years, and 38 three years. Ninety-nine of the lecturers had complete and 24 had partial courses in academies, 138 were high school graduates, 7 had partial high school courses, and 306 had common school education.

### **SPECIAL SUBJECT INSTITUTES.**

Special subject institutes are rapidly growing in favor. Most of the States have held special dairy, fruit-growing, corn-judging, and cattle-judging institutes. These meetings were devoted to the discussion of but one of these topics, were continued from two days to a week, and were conducted by expert instructors who gave practical demonstrations in connection with their lectures.

### **NORMAL INSTITUTES.**

The number of States holding normal institutes for the instruction of their lecture force is increasing. The necessity for equipping lecturers to meet the demands of the institute work is constantly growing more pressing, and the State directors are endeavoring to add to the number of those who can be utilized for instruction work by offering them opportunity to acquaint themselves with the latest information in their several specialties. They are doing this by bringing their corps of instructors together at their State experiment stations and agricultural colleges to hear lectures by the teaching and investigation force at these institutions.

The grade of instruction which the institutes require is constantly being elevated. To effect this the State directors are obliged to select their lecturers with greater care than formerly, and consequently find themselves embarrassed in securing a sufficient number to carry on the work. The necessity for some organized method for supplying competent institute teachers is becoming greater each season, and will doubtless result in compelling the institute managers to employ lecturers for the entire year or at least for such period as will justify competent men and women in making this kind of work a profession to be pursued as continuously as that of a professorship in a college or normal school.

### **ILLUSTRATIVE MATERIAL.**

Frequent requests are received for material illustrative of various agricultural subjects. These requests are no doubt due in part to the fact that the Department has on hand a number of illustrated lectures issued by the Office of Experiment Stations. Requests of this character are likely to become more numerous as agricultural education develops.



The six sets of syllabi of illustrated lectures that were prepared over two years ago have met with general approval. During the past winter these lectures have been in constant demand, showing that they are meeting a want that is quite widely extended, and that they are presenting the topics which the lectures discuss acceptably. The approval with which the lectures have been received seems to justify the extension of this method of giving instruction to include a wider range of topics. With a view to securing additional lectures a number of officials of this Department were requested to prepare syllabi upon subjects with which they were most familiar. As a result engagements have been completed with members of the Department for several such lectures.

In addition to these syllabi by Department officers, arrangements have been completed with specialists outside of the Department for four additional illustrated lectures upon the following subjects: Farm Homes, Farm Architecture, Tobacco Culture, and Farm Poultry.

#### **THE AMERICAN ASSOCIATION OF FARMERS' INSTITUTE WORKERS.**

The twelfth annual meeting of the American Association of Farmers' Institute Workers was held in Washington, D. C., October 23-24, 1907. There were 131 delegates present, representing 25 States and 4 of the Provinces of Canada.

The association was welcomed to Washington by Prof. W. M. Hays, Assistant Secretary of Agriculture, and by Dr. A. C. True, Director of the Office of Experiment Stations. Professor Hays emphasized the importance of providing for agricultural high schools through the country, and outlined a plan for their management. Doctor True called attention to the place that the living teacher has in rural improvement. In speaking of this, he said:

We must have in this country a much more efficient means of getting at the practical farmers through the living teacher, and thus bringing home to them the results of all of the investigation that is going on in their behalf. We have been sending out publications without limit almost, and they have done much good, but more and more I believe that if we stop there we shall have only a very moderate measure of success in educating the mass of farmers for improved practice, but if we can get at them in their own communities with the living teacher, and keep that up year after year, then I believe there is great hope of leavening this whole mass so that agriculture as a whole shall become a really progressive industry and our farmers generally be intelligent and prosperous men.

The president of the association, Prof. E. A. Burnett, of the Nebraska University and Station, directed attention in his annual address to a quality that is in danger of being lost out of modern agriculture through the abandonment of hand work and the substitution of

machinery in carrying on farming operations. He called it the "artisan spirit," or the pride which the individual should take in his calling. He spoke of the practice exercises as carried out in corn and grain growing contests, live-stock exhibitions, and stock-judging classes, the offering of prizes for well-kept farms, and similar contests which require the application of skill and good judgment in farm operations to win, as promising much for the restoration to agriculture of the artistic excellence that seems to have been at least partially lost, and for begetting a spirit of pride in an occupation that affords so many opportunities for the display of business ability and professional skill.

He noted the constantly increasing difficulty in getting a sufficient number of capable institute lecturers, and referred to the introduction of movable schools as a partial remedy, in that it would provide employment for lecturers throughout the year. In his opinion a material service could be rendered by the National Department in furnishing speakers for institutes, in introducing and trying out some of the newer ideas like the traveling institute school and other forms of extension work, and in making known the investigation work of the Department of Agriculture.

The reports from the State, Territorial, and Provincial directors of institutes showed that there is a general realization of the need for better organization in the institute work in order that the instruction may be more economically given and its character improved. The most marked instance of organization reaching all of the people is, perhaps, that now in operation in the Province of Quebec. By virtue of a law passed in 1893 a farmers' club may be established in every parish and every municipality of a township in the Province. The law contains provisions which enable these associations to buy thoroughbred stock and to hold competitions for the best-managed farms, standing crops, etc. Five hundred and ninety-one of these clubs are now organized in the Province, with a membership of 55,141. The membership subscriptions in 1906 amounted to \$69,766.23, and the government aided the various clubs to the extent of \$25,260. Almost every club owns thoroughbred live stock—swine and cattle.

The provincial department of agriculture employs many lecturers to visit the clubs and deliver lectures and give advice. The great improvement of the agriculture of the Province is attributed to the activity of these organizations and their initiative in the introduction of improved stock and seeds and better methods of practice.

The reports also show that the movable schools of agriculture are becoming recognized as valuable adjuncts in institute methods. The equipment of one of these schools consisted of 50 animals, including horses, cattle, sheep, and swine, transported from place to place as a part of a perambulating stock-judging school. These were accom-

panied by a staff of six or eight instructors, all of whom were experts in their line, spending two weeks in each place visited and teaching classes regularly organized for instruction. A hostler, a herdsman, and a shepherd accompanied the stock, feeding and caring for it, and bringing it before the classes for inspection during the class-room hours. At the close of each school a stock-judging contest is held and prizes are offered for the best judging, open for competition to the members of the school only. The two persons standing highest in each school have their fares paid by the department of agriculture to the spring show of live stock for the Province to compete for the grand championship trophy annually awarded by the department.

### COLLEGE EXTENSION WORK.

An examination of the work conducted by the agricultural colleges shows that they are all interested in agricultural extension; that most of them are doing something in this direction, and that a few have organized for carrying on the work in a comprehensive way.<sup>a</sup>

The examination, however, also shows that with the exception of the short courses, which can hardly be regarded as extension in character, the activities of these institutions in the direction of agricultural extension have been along informational and advisory rather than educational lines. They have been engaged in imparting information in agriculture, rather than in providing education. In two or three instances educational work has been outlined, but as yet very little has been actually undertaken.

The dissemination of information respecting agriculture was a necessary preliminary in order to arouse interest in agricultural education. This work has hitherto been engaged in by many organizations not professedly educational. The colleges have joined in this propaganda, and until now have confined their efforts of an extension nature almost wholly to information-giving work.

The time now seems to be at hand for undertaking along extension lines that for which what has been done is preliminary and preparatory, viz, the more specific and extended work of giving instruction in agriculture of an educational character. This work of necessity will devolve upon the educational institutions to conduct. It lies in their field, and is a legitimate part of their activities.

"Information giving" has been and can in the future be carried on by organizations not strictly educational. These organizations should continue to hold meetings, provide for instructive addresses, distribute literature, hold fairs, print papers, and run excursions. Many of these extension organizations have been voluntary, such as clubs, societies, granges, and like associations. Others are under State

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<sup>a</sup> See also U. S. Dept. Agr., Office of Experiment Station Circs. 72 and 75.

auspices, as the farmers' institutes, State dairy associations, State poultry associations, State horticultural associations, etc.

Notwithstanding the fact that their special mission in the future should be to conduct the more strictly educational form of extension, the colleges ought still to assist in carrying on this informational kind of extension work, not perhaps to the extent hitherto required or in the manner formerly practiced. They should certainly do this in States where the control and management of the farmers' institutes are in their hands. Their main work along extension lines ought, however, in the end to be of a more strictly educational character, and to efforts in this new direction their strength in the future should be principally devoted.

While, as has been stated, the colleges without exception commend the idea of extension work in agriculture and are engaged in conducting it to greater or less extent, there seems to be in some directions a fear that in assuming responsibility for this line of activity there is danger of lowering the standard of college work as provided for resident students; a fear that those who complete work prescribed for the extension courses may not be distinguished by the public from those who take the full four years' course in college, and thus that the name of the institution will be brought into disrepute through the impression going abroad that its educational standard has been lowered.

This objection may be met by organizing the extension feature into a separate department of the college with a corps of men to officer it, its lines of work clearly set out in the catalogue for public information, and by having a distinct name to distinguish it from the regular courses adopted for resident students.

#### NEW FORM OF EXTENSION WORK.

A form of agricultural education extension has been undertaken by the State grange of the State of Washington which is quite original and promises valuable results. The officers of the State grange contemplate the preparation of schedules of courses of study upon special agricultural subjects, each course to continue through two or three years, to be taken up by the local granges. Each grange is expected to form classes among its membership in one or more of these courses.

The courses provide for the use of text-books and bulletins for study upon agricultural subjects. Lessons are assigned at each meeting, and papers upon these subjects are to be prepared by the members of the class for presentation and discussion at the next general session. A committee in each grange is appointed to take charge of the classes, and the class exercises are to be conducted in the open meeting.

By this means systematic and extended study of various agricultural subjects are provided for, and the entire membership of the organization is afforded opportunity for improvement both from the study of the lessons and from the general discussion which the study develops.

The method is suggestive in that it is capable of application in the farmers' institute work if the State and local institute societies are properly organized and adequately equipped.

### **AGRICULTURAL EXTENSION IN FOREIGN COUNTRIES.**

Foreign countries for many years have appreciated the importance of instructing rural people in agriculture. In addition to agricultural teaching in their universities, colleges, normal schools, academies, secondary and common schools, numerous special classes of adults are organized in the country districts for instruction by itinerant methods. Professors of agriculture under government direction are sent out to give instruction in the normal and rural schools, and to organize farmers' societies for the promotion of agriculture. Numerous agricultural high schools have been established, particularly in Denmark and Sweden, and are attended by large numbers of rural people of mature years. Demonstration fields, showing the effects of various manures, methods of culture, and varieties of seeds upon crop production, are found everywhere. More than three thousand of these demonstration fields and farms are in operation in France alone.

Movable schools of agriculture form an important part of the educational system in all of these countries. They embrace schools of general agriculture, schools of forestry, horticulture, market gardening, apiculture, aviculture, dairy schools, poultry rearing, farriery, domestic science, and on other similar agricultural subjects. Expert advisers are employed by the State to visit individual farmers and give advice with regard to the methods of operation best adapted to their conditions. Universities and colleges are extending their activities to outlying communities and to farming people who are unable to leave their farms to attend classes at the collegiate centers. The practical results of these efforts are shown in the increased production of these countries as compared with the United States where such systematic efforts have not yet been undertaken.

### **THE LIVING TEACHER.**

It is a matter worthy of special note that most of the information given abroad to farmers is imparted through personal teaching, advice, and instruction, and not through bulletins and books. This fact is most significant in that it is a radical departure from the methods

pursued in the United States, which has thus far depended almost solely in the dissemination of agricultural information upon the printed page, and the slow progress that has been made in agricultural improvement in the United States has no doubt been largely due to the fact that the information that these bulletins, pamphlets, and other printed matter contain has not been brought through personal representatives to the attention of those for whom it is intended.

The movement, therefore, that looks toward the placing of the living teacher in direct contact with the tiller of the soil through the farmers' institute, the movable school of agriculture, and the itinerant advisory professor, as well as the teaching of agricultural subjects to children in the public schools is in the right direction, and is in conformity with the best practice and most successful results secured after many years of experiment in education in foreign countries.

### **PUBLICATIONS.**

The following publications relating to farmers' institutes have been issued during the year:

Bulletin 178, A Course in Fruit Growing for Movable Schools of Agriculture, 100 pages; Bulletin 182, Proceedings of the Eleventh Annual Meeting of the American Association of Farmers' Institute Workers, 90 pages; Circular 51 (revised), List of State Directors of Farmers' Institutes and Farmers' Institute Lecturers of the United States, 32 pages; Circular 72, Report of Committee on Extension Work of the Association of American Agricultural Colleges and Experiment Stations, 8 pages; a reprint from the Office of Experiment Stations Annual Report, 1906, Farmers' Institutes in the United States; and a Revision of Farmers' Institute Lectures 2 and 3, 30 and 28 pages, respectively.

There were prepared for the printer, but not actually issued: Illustrated Institute Lecture on Roads and Road Building, with 41 photographs; Illustrated Institute Lecture on Tobacco Culture, with 46 photographs; Course of Study on Cereal Foods for Movable Schools of Agriculture, 15 lectures with practicums and list of references; Syllabus of Lecture on Selecting Beef Cattle, accompanied by 10 charts painted on canvas, 36 by 42 inches, and two outline cartoons, 36 by 42 inches; and Second Report of the Committee on Extension Work of the Association of American Agricultural Colleges and Experiment Stations. A number of other publications are in course of preparation.

### **STATE REPORTS.**

Numerous items of interest in the reports of the State directors are incapable of tabulation or are peculiar to a particular State, and

at the same time are important to a complete record and understanding of the progress of the institute work as it develops each year. In order that the great body of institute workers may be familiar with this progress the principal points are incorporated in the following narratives under the respective names of the States and Territories:

#### ALABAMA.

Institute director.—C. A. Cary, professor of veterinary science, Alabama Polytechnic Institute, Auburn.

The farmers' institute work in Alabama during the past year was directed principally along the line of the improvement of the live-stock industry with special reference to cattle-tick eradication. Attention was also called by the institute lecturers to the necessity of home production of feed stuffs, rotation of crops, and diversified farming. The work at present is conducted by the board of trustees of the Alabama Polytechnic Institute and the agricultural experiment station. The funds available for institute expenses are altogether insufficient for enabling the State director to make a complete tour of the entire State during any one year. The small sum of \$600 has been all that has been available, and this has been donated from the funds of the Alabama Polytechnic Institute.

Last winter (1906-7) the State legislature appropriated the sum of \$4,000 to the State department of agriculture, which can be used for institute work in part as the department may elect. The expenditure of this sum, however, is wholly in the hands of the commissioner of the department of agriculture and industries, and is not available for use by the State institute director.

During the latter part of July and the first part of August, 1906, a summer school for farmers was held at Auburn continuing through seven days with attendance of 405. Ten to twelve hours' instruction was given each day. The school was made up of representative farmers present from nearly every county in Alabama.

During the year 33 sessions of institutes were held with a total attendance of 2,857. Sixteen members of the agricultural college and experiment station staffs were engaged in institute work, and contributed sixty-four days of time.

Institutes for colored people have been conducted under the direction of the Tuskegee Normal and Industrial Institute. The lecture service is performed chiefly by members of the faculty of the industrial institute. No funds are received from the State for the support of this work, but the expenses are met out of the funds of the institution. The chief work in this direction, however, is at an annual convention or round-up meeting held at the institute and continuing for two weeks, to which a number of teachers are brought from outside of the State to give instruction.

**ALASKA.**

Institute director.—C. C. Georgeson, special agent in charge of agricultural experiment stations, Sitka.

Farmers' institutes have not been held in Alaska, chiefly owing to the fact that the districts adapted to farming are widely separated and sparsely settled. Work of this character for the present is conducted by the special agent in charge of the agricultural experiment station at Sitka as he visits the various sections in the interest of his experiment and demonstration work.

**ARIZONA.**

Institute director.—R. W. Clothier, superintendent of farmers' institutes, Phoenix.

During the past year 20 institutes were held in Arizona, consisting of 20 sessions, with a total attendance of 1,000 persons, at a cost of \$300. The work was conducted for the most part by members of the agricultural college and experiment station staff, six of whom were on the lecture force during the season. The direction of the work has been placed by law in the hands of the agricultural experiment station. The expenses were borne by the experiment station out of a fund which provides for the expenses of the establishment of farmers' institutes and short courses of instruction throughout the Territory. Until recently the general control of the institute work has been in the hands of the director of the experiment station. During the past year a superintendent of farmers' institutes has been appointed who will devote his entire time to the development of the institute work. The leading topic of interest for the Arizona ranchman is water. The moisture conditions determine the location of every farm, and the securing of an adequate supply of water is consequently of paramount importance in Arizona agriculture. The storage of a sufficient supply and the economic use of water furnish, therefore, the principal subjects of discussion.

**ARKANSAS.**

Institute director.—W. G. Vincenheller, director of agricultural experiment station, Fayetteville.

There was nothing done in Arkansas in institute work last year by the agricultural experiment station owing to lack of appropriation for this purpose. Forty-one sessions of institutes, however, were held under the auspices of this Department through Mr. D. A. Brodie, Assistant Agriculturist, Bureau of Plant Industry, who conducted a series of meetings in the southern part of the State. This work was undertaken after consultation with the director of institutes for the State, and meetings were held at 35 different points.



Owing to the excessive rains, which rendered the roads almost impassible, the attendance at many of these meetings was comparatively poor, and the holding of night sessions in the country districts was altogether impossible. The State experiment station cooperated by sending a special speaker on several occasions, and the Bureau of Animal Industry of this Department also contributed the service of one man during a portion of the season.

The last legislature recognized the importance of the institute work by making an appropriation to the agricultural experiment station of \$3,000 for the two years ending June 30, 1909. This appropriation will not be available until the 1st of July, 1907. It is proposed by the institute director to hold a series of institute meetings during the coming year that will embrace the entire 75 counties of the State.

#### CALIFORNIA.

Institute director.—W. T. Clark, superintendent of farmers' institutes, Berkeley.

The work of the farmers' institutes in California the past year consisted mainly of meetings of a general character, although to a limited extent the "special-purpose" institute was further developed. These special-purpose institutes were confined to viticulture or to a phase of this subject. The subject chosen is, so far as practicable, one of direct interest to the locality in which the institute is held. The plan adopted has been to accompany the lectures with practical demonstrations in vineyards, and for this purpose two or three hours in the morning are devoted to the lectures, and the afternoon is spent in the vineyards, where the ideas set out in the lectures are illustrated in practice. The principal topics which have been taken up at these viticultural institutes are the following: Starting a new vineyard; pruning table grapes; pruning wine grapes; pruning raisin grapes; pruning young vines; the Phylloxera of the vine; resistant vines; methods of grafting; Oidium of the vine and methods of control; new varieties of grapes, and fertilization of vineyards.

The interest shown in these special institutes has been very encouraging and the attendance has been quite good, equaling in numbers the average attendance at institutes of a more general character.

During the year 84 institutes were held, consisting of 296 sessions, with a total attendance of 20,470. There was in addition a general institute held, continuing through 8 sessions, with a total attendance of 2,500. The appropriation for the year for institute purposes was \$6,000. The control of the institute work is vested in the regents of the University of California, who are authorized to hold institutes for the instruction of citizens of the State in the various branches of agriculture. They are also authorized to make such rules and regu-

lations as they may deem proper for organizing and conducting the institutes, and may employ an agent or agents to perform such work in connection therewith as they deem best. A brief report of the proceedings of the year's work of the institutes is published and distributed through the regular mailing list of the agricultural experiment station. Twelve thousand five hundred copies of this report were printed and distributed last year. Owing to differences in local climates and leisure seasons in various parts of the State, institutes are held every month in the year.

#### COLORADO.

Institute director.—H. M. Cottrell, superintendent of extension work and farmers' institutes, Fort Collins.

Institutes were held last year in Colorado in every county where there are agricultural interests. One six-day farmers' institute short course was held in Delta, and 112 farmers attended who were not able to spare the time to make the trip to the agricultural college for the regular short course. A tuition fee of \$2 was charged to each member of the class taking the short course, and 14 instructors from the Colorado Agricultural College taught in this course. Sessions were held every day from 8 to 12 o'clock, from 1 to 5, and at night. The success of this method was pronounced, and the college is planning to hold several of these short courses the coming winter. Subjects along agricultural lines will be treated by instructors from the college, the community where the school is held to select the topics. Each course will continue six days, with morning, afternoon, and evening sessions each day. The requirements are that 100 people shall agree to attend, and shall pay a fee of \$2, the community where the short course is held to furnish the hall for holding the school, with heat and light.

Sixty-two regular institutes were held, consisting of 171 sessions, with a total attendance of 16,960. The average attendance at each session was 99. The appropriation for institute purposes was \$4,000 by the State, and \$1,003 were received from other sources. The appropriation for the coming year is \$5,000. Sixteen members of the agricultural college and station staff participated in the work.

#### CONNECTICUT.

Institute directors.—James F. Brown, secretary State board of agriculture, North Stonington; J. G. Schwink, jr., secretary Connecticut Dairymen's Association, Meriden; H. C. C. Miles, secretary Connecticut Pomological Society, Milford.

In Connecticut the farmers' institute management is in the hands of three distinct organizations—the State board of agriculture, the

State dairymen's association, and the State pomological society. Each of these organizations has held institutes during the year. No report has been received respecting the work of the State board of agriculture.

The work of the dairymen's association has been a continuation of the methods in use during the past few years. It is still endeavoring to reach out into new fields and into the back districts with information, with a view to developing and improving the dairy industry in the less favored localities. The association has for the past twenty years or more received an annual appropriation of \$1,000 from the State to help carry out the purpose for which it was created, but during the past two years, owing to the popular demand for more extensive institute work, and as the finances of the association were not sufficient to meet this demand, an increase of \$500 was asked of the legislature and was granted. The influence and inspiration that have gone out from these meetings are beginning to show permanent results in many parts of the State. New barns and stables have been built after the most modern methods of sanitary construction; more thought and care is given to the dairy herds, both as regards feeding balanced rations economically, and in the production of these rations for the cows; and silos for the storing of immense crops of forage are springing up on every hand. The keeping of records of individual cows is a feature of the educational work of the association, and is resulting in its adoption by nearly all of the progressive dairymen. The art of breeding and rearing the dairy cow is receiving attention, and is becoming one of the leading subjects for meetings of the association.

The association cooperates through its director with the granges and farmers' clubs of the several counties. It also utilizes progressive men, professional teachers, successful working dairymen and farmers, in giving instruction in institute meetings. A round-up annual meeting was held last year with an attendance of over 650 people at each session of the two-day meetings. Twenty-three institutes were held during the year, consisting of 49 sessions, with a total attendance of 7,847. The cost of the institutes, including the salary of the secretary of the association, was \$1,040.

The pomological society held 15 institutes made up of 25 sessions, with a total attendance of 1,675 and at an expense of \$325. One field meeting or picnic was held in the summer of 1906, with an attendance of about 200, and there was also an annual winter meeting of the society, continuing for two days, with a total attendance of 2,500. A brief annual report of the work of the farmers' institutes is published in the regular report of the society. The special topics assigned to be discussed at the institutes during the past season were spraying, fruit culture, and the San José scale. Four members of

the faculty of the State agricultural college and three members of the staff of the State agricultural experiment station assisted the lecture force in the institute work, all of the service performed being without compensation excepting the actual traveling expenses.

#### DELAWARE.

Institute director.—Wesley Webb, corresponding secretary, State board of agriculture, Dover.

Institutes were held in all three of the counties of Delaware. In Kent and Sussex two series of meetings were arranged for, each series practically covering the two counties. At every meeting special attention was given to agricultural education. The necessity for procuring a farm for the agricultural college and the experiment station was presented at every meeting, and as a result of this the legislature appropriated money, and appointed a commission to purchase a farm for these institutions. Twelve institutes were held, covering a period of nineteen days and composed of 51 sessions, with a total attendance of 9,210. The appropriation for institute purposes is \$200 to each county. Four of the agricultural experiment station force contributed thirty-four days of service in institute work. The meetings are advertised through the newspapers, by notice given in the granges, by programmes distributed by the school children, and letters to individual farmers. The proceedings of the institutes are made a part of the report of the State board of agriculture, of which 5,000 copies are printed and distributed each year. The special topics assigned for discussion during the coming season are agricultural education, corn breeding, and dietetics.

#### FLORIDA.

Institute director.—P. H. Rolfs, director of the agricultural experiment station, Gainesville.

There was no organization for conducting farmers' institutes in Florida during the year ended June 30, 1907. This was on account of the legislature of 1905 having failed to make an appropriation for institute purposes for the biennium. Although the work was not regularly organized, members of the agricultural experiment station force lectured from time to time at various farmers' meetings during the year. These meetings, however, were of a sporadic character, and could scarcely be classed under the head of institutes. The last legislature, which adjourned June 1, 1907, appropriated a lump sum for carrying on the institutions of higher education. This sum has been put into the hands of the board of education for distribution. Ten thousand dollars has been set aside for farmers' institutes to be used during the next biennium, beginning July 1, 1907. The work of

organizing for the prosecution of the institutes for the next two years has been in progress, and the institutes will be put into active operation as soon as the institute season opens.

#### GEORGIA.

Institute director.—A. M. Soule, president agricultural college, Athens.

During the past year \$2,500 was expended in conducting the institutes, but no record has been secured as to the number of institutes held or the attendance. The work of the farmers' institutes in Georgia has recently been reorganized by the appointment of Prof. A. M. Soule, president of the State college of agriculture, to take charge of the institutes, and application has been made to the legislature now in session for an appropriation to carry on the work.

#### HAWAII.

Institute director.—Jared G. Smith, agent in charge of agricultural experiment stations, Honolulu.

On January 21, 1907, the annual meeting of the farmers' institutes of the Territory of Hawaii was held at the Kamehameha school in Honolulu. The afternoon session was devoted to the business of the organization. The evening session consisted of an interesting programme, and was well attended. Papers were presented upon Hawaiian crop blights, the camphor industry, and there was also an address by the director of the experiment station giving information upon the growth of the several agricultural crops of the Territory within the past decade.

Early in December the Hawaiian Poultry Association held its second annual exhibition, to which the members of the farmers' institute organization were invited, and a joint exhibit was made of poultry and agricultural products. On May 25 a most important meeting of the institute was held, devoted to the furtherance of the new college of agriculture now being founded in Hawaii. The subject of the meeting was "Our new college of agriculture; its aims, principles, and possibilities." To this meeting the official board of regents of the college and prominent educators were invited, and a large amount of valuable information was presented. A report of this meeting was printed in the Hawaiian Forester and Agriculturist for June, 1907, of which 1,000 copies were issued and distributed. Fourteen sessions of institutes were held during the year, with an aggregate attendance of 550, at a cost of \$62.05. Five lecturers from the experiment station were employed in giving instruction in the institutes. The director reports that an annual appropriation of \$2,000 would enable the institute to inaugurate an annual or semi-annual agricultural exposition, which would prove a valuable stimulus to the island agriculture.

## IDAHO.

Institute director.—H. T. French, director agricultural experiment station, Moscow.

Last winter a normal institute was held at Meriden, which extended over five days, and embraced cookery demonstrations as well as other lines of instruction. The total cost of this meeting was \$142.08. The small amount expended for institute work during the year was due to the fact that the legislature curtailed the institute funds two years ago, but last winter the usual appropriation of \$1,000 each year was awarded. The demand for institute work is increasing, and a series of meetings will be held this winter (1907-8), beginning in November. The extended institute of from four to six days' duration is gradually taking the place of the shorter sessions, especially where institutes have been held for two or three years past. Applications for extended institutes have been made by two or three of the leading towns in southern Idaho to be held during the coming winter.

The institute work is altogether in the hands of the agricultural experiment station. The necessity for the immediate rebuilding of the administration building recently destroyed by fire has made it necessary to devote all of the energies of the institution to securing an appropriation adequate for this purpose. On this account no effort was made to increase the amount for institute purposes which has been appropriated during the past few years. It is proposed to continue the demonstrations in domestic economy, particularly along lines of the preparation of foods, and to increase the instruction given along dairy lines for the encouragement of this industry in the State. Some of the localities where institutes have been held during the past few years are now taking the initiative in holding very successful meetings managed by local talent, from which much good is resulting. On account of the great distances to be traveled the institute director has been unable to meet all of the demands presented for institute instruction.

## ILLINOIS.

Institute director.—F. H. Hall, superintendent of farmers' institutes, Aurora.

The Illinois Farmers' Institute is managed by a board of trustees consisting of the State superintendent of public instruction, the professor of agriculture of the University of Illinois, the president of the State board of agriculture, the president of the State horticultural society, the president of the State dairymen's association, and one member from each Congressional district of the State, selected by delegates from the district present at the annual meeting. This board of directors elects a secretary and a superintendent of farmers' institutes. Each county institute is entitled under the law to an appro-

priation of \$75 per year contingent upon its holding one or more institutes of not less than two days' duration, and of which proper public notice has been previously given. The employment of speakers is in the hands of the local institutes as well as the duty of making the arrangements for holding the institutes, such as selecting the location, the preparation of the programme, and securing entertainment for institute speakers. Last year 111 institutes were held consisting of 589 sessions with a total attendance as reported of 333,350, the largest attendance ever reported for any one State. The expenditures for institute purposes amounted to \$27,386.95. This includes the salary of the superintendent, the salary of the secretary, an appropriation to the State board, the amount received from county boards of supervisors, amounts paid in by local subscribers, and appropriations to the counties.

There is no fund for the employment of State lecturers. The director of each district consisting of more than one county is required at the request of the executive committee or superintendent of institutes to call a conference of his district at some convenient point consisting of the president and secretary of each county farmers' institute (or persons selected by them as alternates) for the purpose of arranging the time and place of holding the next county institutes in the district, and of cooperating in securing speakers. The districts referred to are the Congressional districts of the State, each of which is represented on the board of State directors. The approval of the district director is required in fixing the dates of the institutes in his district, and the complete institute programme for each county institute must be submitted to the district director for his approval before having it printed and distributed, at least twenty days prior to the time of holding the institute. An annual round-up institute attended by about 4,000 persons was held continuing through five sessions.

The Grout farmers' boys encampment in Scott County was a feature in institute work that continues to attract interest and seems to be growing in appreciation. Mr. Grout invited all of the boys who had part in the corn-judging classes in the 10 counties of his district to spend the week ending August 4 at one of his farms. Their only expense was to get there. He set up on one of his farms near Winchester five tents, one being a small tabernacle, locating them upon a knoll in a woodland pasture, and also provided cots and plenty of straw. The boys brought blankets. Fifty-four boys came to the encampment. There was a full programme of instruction each day. Professors Farr and Hall, Doctor Hopkins, Mr. Rowe, and Mr. Grout were the instructors, furnishing not only the facts of science relating to agriculture, but also imparting personal inspiration to the young men and placing them in the right attitude toward agriculture and useful living.

The purpose has been to inspire young men who are engaged in agriculture to seek the mastery of their business in all of its principles and details, and to develop within them ambition to know some line of agriculture to its fullest extent.

During this year more than 60 of the 102 counties of the State were represented at the winter short course (two weeks) by young men and women who were winners in the corn-judging and bread-judging contests at the county institutes.

The women's institutes in Illinois have now organized associations in 79 counties, and in all of these they have held meetings during the past year, at which there were 21 speakers, at a cost of \$1,070. An edition of 20,000 copies of the report of the institute proceedings and of the meetings of the women's associations is printed annually.

#### INDIANA.

Institute director.—W. C. Latta, superintendent of farmers' institutes, Lafayette.

During the past year 996 sessions of institutes were held, with a total attendance of 177,441. The expense in conducting the institutes was \$12,700. Eight members of the agricultural college and experiment station staffs were engaged in the work and contributed fifty-four days of time. A report of the work of the year is printed annually, the edition usually being about 1,000 copies. These are distributed among the members of the general assembly, and to active institute workers throughout the State. A conference of the institute workers is held annually at the university at Lafayette. This past year the attendance was about 175, and the conference continued through four sessions. A new institute law was passed by the last legislature and approved by the governor March 9, 1907, which provided for the payment from each county treasury of an annual sum not exceeding \$100 to the county chairman of the farmers' institute, provided there is presented a verified statement giving a true and correct statement of the attendance at such county institute, which statement shall contain the names of the persons so attending; and no name shall be listed as attending unless the person so listed shall have attended at least one full session of such institute and paid a membership fee of at least 25 cents. Such statement shall also show the total amount of membership fees collected at such institute, and a true and correct itemized statement of the expenses of the county institute, the receipted vouchers showing payment in full of all expenses so itemized being attached to such report.

The new law also provides that where there is an organization known as the "women's auxiliary organization" for county institute work, such auxiliary organization may charge and collect an annual membership fee of not less than 15 cents, and upon the president of the auxiliary organization making a verified report to the president.



of the county organization, the auxiliary organization shall be considered a part of the county institute, and the report of the auxiliary organization shall be combined with the report of the county institute. No warrant shall be drawn by the county auditor upon the county treasurer for institute purposes in excess of the total receipts of membership dues for that year.

The committee on experimental agriculture and horticulture of the board of trustees, together with the faculty of the school of agriculture of Purdue University, are intrusted with the carrying out of the provisions of this act.

#### IOWA.

Institute director.—J. C. Simpson, secretary State board of agriculture, Des Moines.

Interest in the farmers' institutes in Iowa is increasing. Eighty of the 99 counties of the State held institutes and received State aid to the amount of \$5,614.53 during the fiscal year ended June 30, 1906. This was an average of \$72.69 to the county, the maximum amount appropriated for each county being \$75. There is a serious defect in the method of reporting which prevents the secretary of the State board of agriculture receiving institute statistics promptly. As the law now stands the itemized expense account is filed with the county auditor and by him with the State auditor. The State auditor then issues a warrant and sends it to the county treasurer, who in turn delivers it to the proper institute officer. Additional reports are sent to the office of the secretary of agriculture, but in this respect the law is not mandatory, and they are often not sent in, or come too late to be of special benefit. It is the opinion of the State director that the law should be changed to require that the reports must be filed in his office as soon as the institutes have been held. They could then be filed and published in bulletin form and be ready for distribution before the institute season again opens in the fall. He recommends that the sum now allotted to each county (\$75) be increased by the next general assembly to at least \$100.

A most important movement for reaching agricultural people with high-grade systematic instruction in agriculture was inaugurated by the Iowa Agricultural College last year. It consisted in the establishment in the college of a department of agricultural extension made up of a series of five schools upon special topics—domestic science, animal husbandry, farm crops, soils, and horticulture.

The need on the part of those who are actually engaged in the business of farming for more extended and exact information respecting the various operations of farm practice became so urgent in Iowa that the subject was taken up by a number of gentlemen interested in the development of her agricultural people. In a conference or

series of conferences held by these gentlemen the subject of methods for securing the better education of farming people was thoroughly discussed. Among the conclusions reached, as stated in the report of the superintendent of agricultural extension, July 1, 1907, were the following:

First, that education extension work is needed; that it is fundamentally correct, being based upon the greatest fact in modern education, namely, that education is for every one, and therefore must be carried to every one. Second, that the people are ready and anxious for it, as shown by the remarkable attendance at meetings of this character, and the interest taken in agricultural education extension work. Third, it was agreed that it should include two lines of work: First, and most important, a force of men who should devote their entire time to discovering the really important agricultural questions, and through such means as short courses, county experiment stations, farmers' institutes, special trains, etc., help to improve these conditions and better the methods, not of occasional persons who are able to attend college, but of every citizen who farms directly or indirectly. It was also argued that out of all this would come greater interest in this greatest and most valuable of occupations—agriculture—and a greater interest in and love for the best of all homes, the farm home. That all this means greater efficiency for the individual—that is, the laborer, the real producer of wealth. Also a greater and better citizenship for Iowa, which after all is the foundation of the greatness of a State. Second, that it should include correspondence schools of agriculture, to the end that men and women on the farms should have some of the benefits of agricultural education. During the winter months there is considerable time at home each day for study. It is practically impossible to go away to attend even a two-week short course owing to the chores which demand attention each day. The importance of this was all the more apparent too from the fact that no agriculture whatever is taught in our rural or city schools.

As a result of the conferences a bill was formulated and introduced before the thirty-first general assembly of the State, which was subsequently passed and approved, April 10, 1906. Under this act the Iowa State College of Agriculture and Mechanic Arts was authorized to organize and maintain a system of agricultural extension work. The college authorities were empowered to give instruction in corn and stock judging at agricultural fairs, institutes, and clubs, and to aid in conducting short courses of instruction at suitable places throughout the State; to give lectures and demonstrations on the growing of crops and fruits, on stock raising, dairying, land drainage, and kindred subjects, including domestic science. The work was to be planned so as to carry to the communities remote from college the benefits of skillful instruction given by the teachers in the State college, and the results reached in the work of the experiment station. An appropriation of \$15,000 was granted for carrying the work into operation. This sum has been increased by the last legislature to \$27,000. A faculty consisting of a corps of ten teachers and assistants was organized, and several of these schools were held in different parts of the State.

The popularity of the method is seen from the fact that there were 1,750 applications for the schools and lectures. Of these, 658 engagements were filled, and 292 meetings were held. Thirty-eight different places have made request for short courses during the coming year, and dates have been fixed for eleven of these, each to continue for about one week. One hundred registered applicants are required before a short course will be granted, and each member must pay a small registration fee. The local people must in addition provide a hall for the meeting, equipment for conducting the work, and pay the expenses of the lecturers while engaged in teaching in the schools. They must attend to the advertising, provide the extra help needed, and look after such other incidental matters connected with the prosecution of the work as may be necessary.

Although the schools have been in operation but one year the results have been quite satisfactory, and the college is greatly encouraged in its efforts in this respect. It is the best equipped and most thoroughly organized effort yet undertaken in this country for reaching agricultural people at their homes with systematic and personal instruction given by capable teachers to selected classes. The results will be watched with great interest by all who are in any way connected with agricultural education extension work.

#### KANSAS.

Institute director.—J. H. Miller, superintendent of farmers' institutes, Manhattan.

The Kansas farmers' institutes are under the direct control of the Kansas State Agricultural College. One hundred and thirty-five institutes were held last year, with a total number of sessions of 358 and an attendance of 20,200. The amount appropriated for institute purposes was \$4,064, and the appropriation for the year ending June 30, 1908, is \$6,300. Fifteen members of the experiment station staff attended the institutes as instructors, and contributed three hundred and four days of service. In addition to the regular institutes there were six picnics, with an attendance of 15,000; two wheat special trains, one over the Santa Fe Railway, continuing six days, with an attendance of 7,300; and one over the Northern Pacific for four days, meeting 3,860 people. There was also an alfalfa train, with an attendance of 16,760. Two agricultural Chautauquas were held, with an attendance of 2,125.

The superintendent of institutes visited 9 of the 21 county high schools and addressed the students on agricultural subjects. Contests in corn have been arranged for in 40 counties, with a membership of 2,794; contests on flowers with a membership of 250, and in gardening of 150. The topics specially assigned for institute discussion

throughout the State were for eastern Kansas, corn; and for western Kansas, wheat. It is proposed that next year's institutes will be devoted to a live-stock campaign accompanied by demonstrations in cattle feeding and dairy work.

#### KENTUCKY.

Institute director.—Hubert Vreeland, commissioner of agriculture, Frankfort.

Institute work in Kentucky has received new impetus by the enactment of a law during the last session of the legislature which gave to the department of agriculture an appropriation of \$20,000 in addition to the \$13,000 already appropriated. The original \$13,000 was for the department of agriculture, labor, and statistics, and as the commissioner is given a wide latitude in the expenditure of this money he can, if the funds are needed, use a portion of it for institute work. The new bill provides for a state board of agriculture, forestry, and immigration to be operated in conjunction with the bureau of agriculture, labor, and statistics. The commissioner of agriculture is by virtue of his office chairman of this board, and the director of the experiment station is an ex-officio member. There is also a member from each appellate court district in the State elected by the farmers' institutes of their special districts at the time of the annual State round-up meeting. Of the \$20,000 appropriated, \$2,000 are to be used for forestry and \$2,000 for immigration, and for salaries for clerks to the extent of \$3,000 a year, leaving \$13,000 which can be used for the holding of farmers' institutes. During the last fiscal year the department has held a two-days' institute in each of the 119 counties of the State, and in a few of the counties two institutes have been held. The institutes are advertised from four to six weeks in advance and the effort is to make them a county affair, attracting visitors from all sections of the county in which the institute is held.

The law appropriating the original \$13,000 for the bureau of agriculture, forestry, and immigration provides that the commissioner may offer premiums for the products of the State. It has been found that this has a tendency to create interest at the institute, and begets a friendly spirit of competition as well. During the last year the farmers brought live stock to the doors of the court-house or other places where the institutes have been held, where they were judged for points by experts in the presence of the farmers. At the State farmers' institute held in Shelbyville in February there were several fine specimens of both beef and dairy types exhibited on the opera-house stage and judged before a large audience. This was an especially attractive feature. With the present appropriation Kentucky is in position to take place in the first rank of the States in the holding of institutes. There is at least one permanent institute organization in every county in Kentucky.

**LOUISIANA.**

Institute director.—Charles Schuler, commissioner State board of agriculture and immigration, Baton Rouge.

A number of institutes were held during the months of February and March in 1906 through some of the parishes in the northern part of Louisiana, and although they were fairly successful the interest as shown by the attendance was not as great as in the previous year. The commissioner of agriculture conducted several of these institutes, with the assistance of four professors from the State agricultural college and experiment station and two ladies from the industrial institute at Ruston. The giving of instruction in domestic science was introduced two years ago into the farmers' institutes and has been continued during the past season under the superintendence of teachers from the industrial institute, with added interest and profit. The institute director has made special effort to have the institute work placed under the supervision of a special institute director, and requested the general assembly at its last session to grant authority to appoint an officer of this kind who could devote his entire time to the supervision and conduct of the work. The legislature did not grant the commissioner's request, and the institutes are consequently still in the hands of the commissioner as heretofore.

Ten institutes were held, consisting of one session each, with a total attendance of 500. The commissioner has concluded to abandon the institute work in Louisiana until the legislature provides an officer who shall have charge of its development, and be able to give it his undivided attention. The annual appropriation of \$2,000 for institute purposes was made by the legislature as in former years.

**MAINE.**

Institute director.—A. W. Gilman, commissioner of agriculture, Augusta.

Farmers' institutes were held in all of the counties of the State last year excepting Aroostook, where the farmers' institute special train made an extended trip. The institutes numbered 33, composed of 65 sessions, with a total attendance of 4,771. Six institutes were held in connection with the granges and farmers' clubs, with an attendance of 720. A dairy conference, continuing through three days with an exhibit of dairy products and machinery, was held, attended at every session by a large number, and much interest was manifested. The amount appropriated for institutes by the State is \$3,000. This does not include the salary of the superintendent. Two members of the faculty of the agricultural college and one from the staff of the agricultural experiment station were upon the institute force. A summary of the work of the institutes during the year, with abstracts of

a number of lectures delivered at the various meetings, are published in the annual report of the department, 6,000 copies of which are printed and distributed through the members of the legislature, the agricultural societies, granges, farmers' institutes, and other agricultural organizations.

#### MARYLAND.

Institute director.—W. E. Amoss, director of farmers' institutes, Benson.

In Maryland 23 institutes were held during the year—6 one-day, 15 two-day, and 2 three-day—made up of 121 sessions. The total attendance was 9,833, and the amount appropriated for institute purposes was \$6,000. A summer school of institute people was held at the Maryland Agricultural College, which was subdivided into 24 classes, and continued through 10 sessions, with an attendance of 169. A boys' session is held in connection with each institute, and a number of women's institutes upon poultry, dairying, and home sanitation subjects were held during the year. One institute for colored people was conducted, with an estimated attendance of 300. A number of the papers submitted by the colored farmers were more than ordinarily interesting and instructive. The superintendent calls attention to the importance of local organization in his farmers' institute work. He states:

I have been working for twenty years for local institute organizations in this State. When first given charge of the department I had in mind the importance of organization among the farmers. \* \* \* It has been fortunate for me that in the past it was necessary for me to attend all of the institutes, for it has brought me in close touch with the people and given me a knowledge of their needs and the conditions under which they are living. The time has come when the work of the department has grown to such an extent that it will not hereafter be possible for me to be present at all of the institutes, which I regret very much.

The experience of this director is common to all of the States in which the farmers' institute work has developed into anything like considerable proportions. The management is being compelled to adopt some form of local organization in order that the work may be continued and expanded.

#### MASSACHUSETTS.

Institute director.—J. L. Ellsworth, secretary State board agriculture, Boston.

There were 155 sessions of institutes held last year in Massachusetts, attended by 19,692 persons. The average attendance at each session was 127, an advance upon the previous year. The amount appropriated for institute purposes was \$2,750. A "better farming special" train was run, and a field meeting of the board of agriculture was held for demonstration work. Nine members from the

faculty of the State agricultural college and five from the staff of the State agricultural experiment station were employed upon the institute force. An additional thousand dollars was received for institute work from the legislature, but this appropriation came too late in the season to be available during this year. In Massachusetts the institute meetings are held under the auspices of the local agricultural societies, so that in every county there is an organized body responsible for the work. The dates, places, and programmes of the several institutes are arranged for by the board of agriculture after consultation with the local societies. In connection with the institutes, bulletins, crop reports, nature leaflets, and reports of field meetings are issued periodically by the State department of agriculture.

#### MICHIGAN.

Institute director.—L. R. Taft, superintendent farmers' institutes, Agricultural College.

The farmers' institutes held during the past year have given evidence of increased interest in such gatherings in nearly all of the counties. The number of the so-called county institutes has been 70. This provided one for nearly every county of the lower peninsula and for ten of the counties of the upper peninsula.

Although the winter season as a whole was quite favorable to the securing of large meetings, severe storms and bad roads considerably reduced the attendance in quite a number of the counties.

With few exceptions the institutes lasted for two days each, but in a number of cases, including Manistee, Barry, Berrien, and Oakland, three-day institutes were held, while in other counties it was preferred to hold the meetings only one day for the county institute and thus secure an increased number of regular one-day institutes.

The number of one-day institutes has been 259.

The attendance has varied considerably in some of the counties as compared with previous years. This has been due in some cases to the fact that the weather may have been either more or less favorable than last year, but it has generally resulted from the fact that many of the meetings have been placed at points where institutes have not been held before and where as the people knew little regarding the aims and objects of the meetings they took less interest than would have been the case at points where institutes had been held previously.

The speakers have for the most part been the same as in previous years, although a few persons have been added to the force. Although some were undoubtedly handicapped by being unfamiliar with the methods used in conducting meetings, the recruits have, in the main, given excellent satisfaction and in another year will be able to take

their places with the more experienced speakers. Several of those added to the lecture force are graduates of the agricultural college who have demonstrated upon their own farms the correctness of the principles learned while in college and whose training has fitted them for taking up institute work.

At the close of each meeting reports are sent in by the president and secretary of the county institute society, the chairman of the women's section, and others regarding the interest taken in the various topics and the impression made by the speakers. With a very few exceptions the reports have been very favorable.

As in previous years, the work of carrying on institutes has been greatly assisted by the members of the faculties of the various normal schools and the State university, who have frequently given their time.

The success of the one-day institutes in Barry County, at which the county commissioner of schools cooperated by furnishing a speaker for the afternoon and evening sessions during the institute season of 1905-6, led to the adoption of the same plan in a large number of other counties. In some cases the speakers were from other counties, or even from outside the State, and this plan has proved very satisfactory.

During the year 18 members of the college faculty have assisted at the institutes. For the most part they have devoted but one or two days each to the work, but several have attended from five to eight meetings. The total number of days devoted by members of the faculty to attending the regular institutes have been fifty-seven, and a total of forty-three days was given to the railroad institutes and eighteen to the round-up institute. The assistance rendered by the members of the college faculty and the staff of the experiment station has been considerably less than in previous years, owing to the increase in the number of students, particularly in the short courses which are given at the time the institutes are held.

The annual round-up institute was held at Ionia upon the invitation of the Ionia County Farmers' Institute Society at the close of the regular series. The weather during the week was very favorable and there was a large attendance, not only from Ionia County, but from all parts of the State. The number present at several of the sessions ranged from 1,400 to 2,000 persons, and the opinion was generally expressed that it was the most successful meeting of its kind ever held in the State.

During the week several conferences of delegates from the county institute societies and the institute lecturers were held, at which the work of the past year was discussed and plans made for carrying on the work during the coming year.



There was a general desire for an increase in the number of institutes and for a larger equipment in the way of charts and models for the use of the institute lecturers. In order that this might be secured a motion was unanimously passed asking the State board of agriculture to set aside \$12,000 for farmers' institutes in 1907-8. This was also included in the report of the committee on resolutions and was adopted without a dissenting vote.

#### MINNESOTA.

Institute director.—A. D. Wilson, director of farmers' institutes, St. Anthony Park.

One hundred and thirty-nine institutes were held in Minnesota last year, composed of 282 sessions, with an attendance of 67,063. The total cost of the institutes was \$18,170. The work was conducted along much the same lines as during the past years, and with increasing interest, as is shown by the large attendance, which was much greater than in former years. An institute annual containing papers and addresses delivered at the institutes was prepared and published by the institute board of administration and 35,000 copies were distributed. The institute director, Mr. O. C. Gregg, who has been continuously in charge of the institute work in Minnesota since its inception, was at his own request retired from active service and Mr. A. D. Wilson, of the Agricultural College of Minnesota, was appointed director in his stead.

#### MISSISSIPPI.

Institute director.—E. R. Lloyd, director of farmers' institutes, Agricultural College.

There has been increased interest in the farmers' institutes in Mississippi during the past year. The number of institutes held was 148, as against 110 the previous year, with 296 sessions, as against 220 sessions in 1906. The attendance was increased from 10,000 in 1906 to 17,945 in 1907. The appropriation for institute work was \$3,000. Fourteen members of the State agricultural college faculty and of the experiment station staff assisted in institute lecturing, contributing two hundred and ninety-four days of time. About 50 local speakers addressed the institutes in addition to the regular instructors. There were four independent meetings, with an estimated attendance of 3,000, and a round-up institute continuing through 8 sessions, with an attendance of 300. A railroad special was run through the State during a period of eight days, with an attendance of 9,127. Four corn-growers' clubs were organized, with a membership of 200.

An effort will be made during the coming year to time the holding of institutes and the subjects to be discussed to periods immediately

preceding the time at which the information can be put into practice. Instead of discussing the use and application of fertilizers several months before fertilizers are applied the discussion will be deferred until immediately before the time for planting the crops. In order to accomplish this more institutes will be held, and the discussions will be confined to one or at most two subjects at any single meeting, and instead of holding all of the institutes in the late summer and autumn a part of the meetings will be held in the spring from the middle of February to the middle of April.

During the past year several counties have organized institute clubs, each club taking the name of the county in which it is located. The president and secretary are chosen from near the center of the county, and one vice-president from each supervisor's district. This plan brings the club, through its officers, in close touch with the people in every part of the county. Eight county high schools have organized boys' corn-growing clubs, with an average membership of about 75. To assist and encourage this work the farmers' institute department publishes a corn bulletin for the use of the clubs and furnishes lecturers and judges. A short winter course in agriculture has been established at the agricultural college under the management of the institute department. This season a few two-day institutes were held, with the afternoon session devoted largely to practical demonstrations, as clinics, stock judging, grafting, budding, and pruning. The farmers took great interest in the practical work. The director, in commenting upon this, states that he thinks that as long as the practical side of the institute work is kept on an educational basis good results must follow, but that he does not believe that it is the function of an institute lecturer to examine and treat the diseased and lame animals of a community, acting merely as a veterinary surgeon, but that this is only permissible when these animals are used for demonstration purposes. The field institutes which were held during the year were so satisfactory that a larger number will be held next season.

#### MISSOURI.

Institute director.—George B. Ellis, secretary State board of agriculture, Columbia.

Two hundred and twelve institutes were held in Missouri during the year; 178 were one-day meetings, 33 were two-day, and one a three-day meeting. The number of sessions was 372, and the attendance 46,511. A round-up meeting was held, continuing through 9 sessions, with an attendance of 1,500. The annual appropriation for institute purposes is \$5,000 a year. The arranging of dates, places, and programmes is by the secretary in consultation with the local organizations. Eleven members of the faculty of the State agri-

cultural college were upon the lecture force. A report giving an abstract of the proceedings of the institutes is published each year numbering 10,000 copies. The special topics discussed throughout the State were road improvement and improvement in corn culture.

#### MONTANA.

Institute director.—F. B. Linfield, director agricultural experiment station, Bozeman; F. S. Cooley, deputy superintendent of farmers' institutes, Bozeman.

Last winter (1906-7) the legislature of Montana increased the annual appropriation for farmers' institutes from \$4,000 to \$7,500. This has made it possible for the board of administration to secure an assistant director of farmers' institutes to take control of the institutes of the State. Prof. F. S. Cooley, of Amherst, Mass., was engaged as superintendent of farmers' institute work. The meetings during the past year were fully up to the average of other years, though the weather during the month of January interfered in the northern part of the State to a considerable extent.

The total number of institutes held was 70, composed of 78 sessions, with a total attendance of 7,541. The appropriation for the past year was \$4,000. Thirteen members from the college faculty and from the experiment station staff were engaged in institute work and contributed two hundred and five days of their time. Five thousand copies of the reports of the proceedings of the institutes are printed annually and distributed.

#### NEBRASKA.

Institute directors.—E. A. Burnett, director agricultural experiment station, Lincoln; Val Keyser, assistant superintendent farmers' institutes, Lincoln.

The law governing farmers' institute work in Nebraska provided an appropriation from the general fund of \$20,000. This is controlled by the regents of the State university. The management of the institutes is in charge of a superintendent and an assistant superintendent. The office of the department of farmers' institutes is at the experiment station, and all dates are fixed and speakers sent out by the office.

The legislature also passed an act, which became operative in July, 1905, authorizing the board of county commissioners of any county in the State to defray the local expenses connected with farmers' institutes, not to exceed \$100 per annum in any county. Before any farmers' institute can take advantage of this appropriation it shall be duly organized with a president, a secretary-treasurer, an executive board of not less than three members, and a signed membership of not less than 50 actual farmers, and no money shall be paid for the expenses of any institute not held in cooperation with the University of Nebraska.

The last institute season opened November 20, 1906, and closed March 12, 1907. One hundred and thirty-six institutes were held, and 65,419 persons were reported to have been present at these various institutes. The State appropriation for last year was \$6,000, and the local expense reported was \$2,684.04. Part of this was appropriated by the county commissioners. The number of institutes held has decreased from 160 in 1905-6, with 515 sessions, to 136 institutes and 442 sessions in 1906-7. This decrease was partly due to the fact that the railroads were not permitted to issue free transportation for the speakers, and the number had to be reduced to bring the expense within the appropriation.

No round-up institute is held, its place being taken by the meetings of organized agriculture the third week of January. Over 1,500 people attended these meetings in 1907, representing seventeen different State agricultural associations. Among these meetings was the farmers' institute conference of the speakers and officers of local institutes, held on Friday, January 18. About 200 were present. The object of the conference was to discuss methods pertaining to the management of farmers' institutes.

The department is planning to hold 175 institutes during the coming season, which opens December 3, 1907, and ends March 7, 1908. Nearly all the dates have been fixed. Special attention will be given to the women's work of the farmers' institute. The new features proposed are illustrated lectures and stock-judging demonstrations. So far as practicable the boys' and girls' associations will also hold their county contests in connection with the local farmers' institutes. A set of bulletins pertaining to the corn-contest work is being published by the department of farmers' institutes in cooperation with the State department of education for distribution among the contestants.

#### NEVADA.

Institute director.—J. E. Stubbs, president Nevada State University, Reno.

No institutes were held in Nevada during the year.

#### NEW HAMPSHIRE.

Institute director.—N. J. Bachelder, secretary State board of agriculture, Concord.

Institutes were held in every county in New Hampshire with one exception. The entire number was 15 and the number of sessions 34, with a total attendance of 3,500. The amount appropriated for institute purposes was \$1,600, and the appropriation for the coming year is \$2,000. Four members of the faculty of the State agricultural college were engaged in institute service and contributed sixteen days of time. Two thousand copies of the proceedings of the meetings were published and distributed.

**NEW JERSEY.**

Institute director.—Franklin Dye, secretary State board of agriculture, Trenton.

Forty-four institutes were held last year, 36 one-day and 8 two-day. The total number of sessions was 132 and the attendance 10,399. An annual round-up meeting was held, continuing through 8 sessions, with a total attendance of about 1,250. A summer meeting of the State board of agriculture was held at New Brunswick for inspecting the work of the college farm. The total attendance at this meeting was about 800 persons. The appropriation for institute purposes was \$3,060. There were nine speakers upon the force of institute lecturers.

There are no county institute organizations and no report of the proceedings of the institutes is published. The principal topic for discussion during the past year was agricultural education. The superintendent reports, in answer to the question, "In what respect do you need assistance in your work?" "Getting on quite well."

**NEW MEXICO.**

Institute director.—J. D. Tinsley, superintendent of farmers' institutes, Agricultural College.

The farmers' institute work of New Mexico is under the direction of the agricultural college and experiment station. There is no specific legislation providing for the organization and expense of the institute work. The expenses are met by appropriations made by the board of regents of the College of Agriculture and Mechanic Arts and the experiment station. Twenty-four one-day institutes were held last year, having a total of 29 sessions, 970 persons were in attendance, and 3 lecturers, all members of the station staff, gave instruction at these meetings. Twenty-seven towns were visited, 9 farmers' institute societies were organized, committees on organization were appointed in 9 towns, and in the 9 others no steps toward organization were taken. The total expense amounted to \$1,900. No report of the proceedings is published. The citizens in the localities in which the meetings are held pay all the expenses of the meetings except those incurred by the State lecturers. The advertising of the institutes is committed to the localities in which the meetings are to be held.

**NEW YORK.**

Institute director.—F. E. Dawley, director of farmers' institutes, Fayetteville.

New York held 834 sessions of farmers' institutes last year, attended by 105,196 persons, or an average per session of 126. These institutes were held under the regular institute appropriation. In

addition there were held 25 independent institutes, to which State speakers were sent, with an attendance of 22,600. The annual appropriation for institute purposes is \$20,000. In addition a speaker is furnished for each institute by the department of education to speak upon the subject of education. About 70 persons are on the State civil-service roll as institute lecturers, and during the year something over 400 other teachers, essayists, and local speakers have assisted in giving instruction at institute meetings. The attendance is fully up to former years, and the interest is constantly increasing.

Preceding the regular winter's series of meetings a normal institute was held at the State experiment station at Geneva. Next year it will be held at the agricultural college at Cornell University. Formerly both these institutions have been visited and sessions of the normal institute held at them each year; but it is believed that better results will be obtained from holding the entire normal institute at one institution each year, speakers from both being present. The value of the normal institutes, which were first established in New York State, is more apparent each year, and the syllabi of the lectures are of great value to the institute workers later in the season.

The special fruit growers, poultry breeders, and bee-keepers' institutes are increasing in popularity each year. The institute held in connection with the annual meeting of the American Poultry Association, at Auburn, has resulted in an educational bureau having been established in that association, and accredited speakers on the subject of poultry will be available in all the States as soon as this branch of the association's work can be organized.

Special sessions for young people have been continued and were most satisfactory. The work of holding women's institutes is popular and is becoming more thoroughly established each year. Fifteen thousand copies of the institute proceedings are published and distributed, 10,000 through members of the legislature and 5,000 through the department of agriculture. During the past year the three special topics of the year before were continued—rural schools, better roads, and alfalfa growing.

#### NORTH CAROLINA.

Institute director.—Tait Butler, State veterinarian, Raleigh.

The total number of institutes held in North Carolina in 1907 was 124, all one-day institutes. The number of sessions was 246, and the total attendance was 31,980. A round-up institute was held, continuing through 8 sessions, with an attendance of 4,000. Six members of the agricultural college faculty and station staff contributed eighty days of service in institute work. The appropriation for institutes was \$4,000. This does not include the cost of the annual report nor the expense of printing advertising matter, nor does it in-

clude the salary of the director. These items would add about \$2,500 to the expense, making the total \$6,500. An appropriation has been made by the board of agriculture for institute work for the six months ending November 30, 1907, of \$3,750. Thirty thousand copies of the institute proceedings are published and distributed through the mailing department of the State department of agriculture as monthly bulletins. Institutes for women have been a feature of the work during the past year. Thirty special women's institutes have been held with very satisfactory results. This is an increase of nine over the number of women's meetings last year.

#### NORTH DAKOTA.

Institute director.—T. A. Hoverstad, superintendent of farmers' institutes, Fargo.

A large number of institutes were scheduled for North Dakota last year, but owing to the excessive amount of snow and extreme cold during the winter it was found difficult to continue the institutes, so about the 1st of February they were discontinued and taken up again in June. This accounts for the decrease in the number of institutes and in the attendance. Twenty-five institutes were held in all—5 were one-day, 19 were two-day, and 1 three-day. The total number of sessions was 99, and the attendance 9,709. The appropriation for institute purposes was \$6,000. Two members of the State agricultural experiment station staff participated in the work, contributing forty-two days of time. The dates, places, and programmes for the institutes are arranged by the superintendent subject to the approval of the board of control. Ten thousand copies of a report of the meetings were printed and distributed. The special topic discussed at the institutes throughout the State was "good seed."

The institute director, Prof. E. E. Kaufman, owing to ill health, resigned during the year, and Mr. T. A. Hoverstad was elected in his place. There were no particularly new features introduced, and it is proposed to continue to work along the old lines for the present, endeavoring to make the instruction as effective as possible. Settlers are coming into the State by the thousands, so that the work has to be adapted largely to the demands of the various new districts that are being occupied.

#### OHIO.

Institute director.—T. L. Calvert, secretary State board of agriculture, Columbus.

Reports from the farmers' institutes held in Ohio during the season of 1906-7 are encouraging. Under the amended law a much larger number of meetings can be held than ever before; 257 were held this year, with the prospect of a gradual increase until the total number

provided for under the amended law (4 in each county, or a total of 352) is reached. Stormy weather, which prevailed during the greater part of the winter, and bad roads interfered to some extent with the attendance, but the interest in the work is growing, as is evidenced by the readiness of farmers to take part in the discussion of live topics.

The amendment to the Ohio institute law, passed by the general assembly March 31, 1906, making a direct appropriation of funds instead of a per capita allowance, went into effect during the season of 1906-7. This change must prove beneficial, as it gives the farmers in all counties, without regard to population, an opportunity for enjoying the educational advantages of the institute. This law provides that the president of the State board of agriculture shall receive \$125 from each county in which an institute is held, and the president of each institute society holding its meeting under the auspices of this board is entitled to receive from the county auditor an amount to cover its expenses, but not to exceed \$31.25, the number of State institutes in a county being limited to four.

During the season of 1906-7 there were 1,495 sessions of institutes held, with an attendance of 92,303, at an average cost per session of \$13.32. Twenty-five independent institutes were reported, with an estimated attendance of 10,000. The State farmers' institute was omitted this year in order that the agriculturists, horticulturists, and stock breeders of the State might be given an opportunity to attend the meetings of the American Breeders' Association, which met in Columbus, January 15-18, 1907. Fifteen thousand copies of the institute report have been printed for distribution. The method of distributing is to send a box containing agricultural reports and institute reports (from 35 to 40 of the latter) to each institute, whether a State institute or an independent meeting, to be distributed by the institute officials. This places them in the hands of those who want them. They are also sent out by mail upon request.

No new work has been undertaken this year nor is any contemplated at present.

#### OKLAHOMA.

Institute director.—C. A. McNabb, secretary State board of agriculture, Guthrie.

Institutes were held last year in every county in Oklahoma excepting one. The total number was 40—18 one-day institutes and 22 two-day. The total number of sessions held was 99, and the total attendance 6,715. No direct appropriation was made to the State board of agriculture for institute support, and consequently the expenses so far as the State director was concerned were paid out of the contingent fund of the State board of agriculture. The State agricultural



college also contributed toward meeting the expenses. The total cost aggregated about \$550 for the year. There were ten independent institutes held, with an aggregate attendance of 3,000, and a round-up institute continuing through seven sessions, with an attendance of 1,000.

The constitution of the new State of Oklahoma creates a board of agriculture appointed by the governor, which takes the place of the old board of agriculture, the live-stock and sanitary commission, and the board of regents of the Oklahoma Agricultural and Mechanical College. It has the future of the development of Oklahoma more fully in its hands than has the board of agriculture in any other State. Under the constitution the president of the board of agriculture is also a member of the school land commission.

#### OREGON.

Institute director.—J. Withycombe, director of the agricultural experiment station, Corvallis.

Sentiment in behalf of the institute is steadily growing. It is now generally recognized by all progressive farmers as a potent factor in the development of better agricultural practices. This feeling is steadily becoming more widespread among all classes of farmers. Even in the exclusively grain-growing sections, where a few years since no interest was taken in institutes, now they are calling for more institutes.

The value of the institute is more marked, however, in districts where intensive methods of agriculture are followed. This is manifested by increasing interest in better grades of live stock, the growing of a wider range of forage plants, and a better utilization of the land. Another helpful feature has been to strengthen the sentiment among the farmers for closer cooperation and organization. The social side of farm life has been improved through the influence of the institute in promoting an interest in better reading through the traveling libraries; improvement of the farm home by adding inexpensive but modern conveniences. This has been an especially strong feature of our women's work.

The home canning of fruits and vegetables has also proven to be a very interesting subject. The coming year samples of the canned products will be placed on exhibition at the institutes.

A greater use has been made of charts during the past year. These, with practical demonstrations, especially in pruning fruit trees, have been found very helpful. The stereopticon is very popular for evening sessions, and is a strong educational feature of the institute. It is used mainly to illustrate modern homes, types of live stock, and well-kept farms and orchards.

**PENNSYLVANIA.**

Institute director.—A. L. Martin, deputy secretary of agriculture, and director of farmers' institutes, Harrisburg.

Institutes in Pennsylvania for the past year numbered 394, consisting of 981 sessions, with a total attendance of 147,895. The total amount expended in institute work was \$20,500. The appropriation for the year ending June 30, 1908, is \$23,000. The total number of local speakers that addressed the institutes was 252. Seven members of the faculty of the State agricultural college, and of the staff of the experiment station engaged in lecture service, and contributed one hundred and three days of time. Ten independent institutes were held with an estimated attendance of 3,000, and a round-up institute extending through seven sessions, with an attendance of 2,000. One women's session was held at every two-day institute, numbering in all 346 sessions. Ten thousand copies of the annual report of institute work were printed and distributed. The principal topics of discussion during the year were soil improvement, dairying, poultry culture, market gardening, and educational and social problems.

The few movable schools of agriculture that were held in 1906 have led to arrangements for holding one of these school meetings in each Congressional district in the coming year. These schools embrace three distinct lines of study—dairying, horticulture, and poultry. A syllabus of the subject to be studied is printed and put in the hands of the members of the several classes who have previously enrolled their names. The purpose of the school is to provide more thorough instruction than can be obtained in the general institute, in order that the farmers may be better equipped in their several specialties for the more successful prosecution of their work. The great difficulty at present is in securing instructors qualified for imparting the technical and practical teaching which these adult scholars require.

**PORTO RICO.**

Institute director.—D. W. May, special agent in charge of the agricultural experiment station, Mayaguez.

No institutes were held in Porto Rico last year. The insular legislature has made no appropriation for carrying on this work. The commissioner of agriculture, however, has taken it up and contemplates holding meetings at which the members of the station staff expect to give instruction. The policy of the station thus far has been to visit individual plantations, giving advice. This for the present seems to reach the planters more satisfactorily than the general meeting, due perhaps to the large size of the plantations requiring special treatment in each individual case. This, it is found, can best be given through personal inspection of the conditions attending each.

**RHODE ISLAND.**

Institute director.—John J. Dunn, secretary State board of agriculture, Providence.

Seven institutes were held in Rhode Island, consisting of 9 sessions, with a total attendance of 600 persons. The cost was about \$75. Four members of the faculty of the State agricultural college and 7 lecturers from the staff of the State agricultural experiment station were engaged in institute work during the year. Arrangements for holding the institutes, including the dates, places, and programmes, is in the hands of the secretary of the State board of agriculture. The board, under the law, is required to hold one agricultural institute in each county annually, and may hold as many more as it shall deem expedient. The expenses of the board are paid out of an annual appropriation of \$20,000 appropriated for the purpose of carrying out the several provisions of the act under which the board is constituted.

**SOUTH CAROLINA.**

Institute director.—J. N. Harper, director agricultural experiment station, Clemson College.

Authority to hold farmers' institutes in South Carolina is, by act of assembly, given to the board of trustees of the Clemson Agricultural College. The general management of the work has been placed by the board in the hands of the director of the agricultural experiment station. Last year 73 institutes were held; consisting of 93 sessions, with a total attendance of 13,219. The amount appropriated for institute work was \$3,000. A round-up institute attended by about 800 persons and continuing through 9 sessions was held at the college in the summer of 1906. County institute organizations have not yet been formed. Arrangements have been completed for securing the publication of the reports of the proceedings of the various meetings. The director selects the dates at which the institutes are to be held. The places are designated by the institute board of trustees of the college, upon invitations signed by at least fifteen persons in the locality desiring the institute. All of the institutes last year were conducted at places which were reached by the Southern Railway, which furnished special coaches free to the college for the transportation of illustrative material and the lecture force.

**SOUTH DAKOTA.**

Institute director.—A. E. Chamberlain, superintendent of farmers' institutes, Brookings.

The regular institute work during the past year was commenced November 12, 1906. It was found that owing to the excessive rains and consequent delay in farm work the meetings had been begun

nearly thirty days too soon. In the month of August three special corn meetings were held in different parts of the State, which were addressed by Prof. P. G. Holden, of Iowa. These were largely attended and great interest manifested. At the leading fairs a demonstration of methods of testing seed corn was provided, with an expert to explain and discuss the subject before the visitors. These demonstrations were given in the agricultural buildings at the fairs and attracted very much interest. During the week before Christmas there was held in Mitchell a four-day corn school and corn show. Regular classes were formed of the farmers who attended, and work in scoring corn and discussions concerning it were carried on with much enthusiasm during the entire period of the meeting. Prof. A. N. Hume, of Illinois, and Prof. John S. Cole, of the agricultural college, conducted the class work. There was also organized at that time a State corn growers' association, which will meet annually in the future.

There were held one hundred and thirty-one days of institutes, besides the special work already mentioned. The number of sessions was 280 and the total attendance 26,000. The total cost of the work outside of hall rent and incidental local expenses was \$4,999.94. The hall rent and the expenses of local advertising were paid by the local people.

The institute director has not been able as yet in this State to take advantage of the provision of the State law requiring counties to contribute \$200 each to the expenses of institutes. The authorities in some counties are willing to do so and in others they have hesitated. For that reason no attempt has been made to insist upon this feature of the law, except where the county commissioners are found willing to appropriate money for some special feature of the work, as the expenses of the special lectures such as were given by Professor Holden last year. The legislature at its last session appropriated \$2,000 additional per year for institute work, making \$7,000 annually.

About 10,000 blanks are being sent out to as many farmers asking them to count and return their stand of corn, basing the stand upon 300 hills counted at places in the field where the stand is about an average. By this it is expected that the attention of the farmers will be directed to the importance of using good seed corn. It is proposed to follow this up this winter in the institutes with a general discussion of the importance of good seed generally.

Some 3-inch glass tubing has been secured for the purpose of demonstrating at the meetings to be held the coming year the movement of moisture in soils. Particular stress will be laid upon the matter of preventing evaporation and upon the proper preparation of the seed bed. These two features of the work will be made leaders next season. It is expected also to present one or two illustrated lectures each day by means of the stereopticon.

**TENNESSEE.**

Institute director.—John Thompson, commissioner of agriculture, Nashville.

Forty-eight institutes were held in Tennessee during the year, comprising 51 sessions, with a total attendance of 10,400. The appropriation for institute purposes was \$5,000. The force of institute lecturers numbered six, four of whom were from the staff of the State experiment station, who contributed forty-eight days of service. Nine independent institutes were held, with an estimated attendance of 780. The commissioner of agriculture secures the lecturers, arranges the programmes, and decides the places and times for holding the institutes. Three thousand copies of institute reports were printed and distributed. One general programme was made out for the whole district of west Tennessee. The subjects for discussion were live-stock possibilities, horticultural problems, leaks on the farm, poultry, State and county fairs, the farm dairy, and soils and fertilizers.

**TEXAS.**

Institute director.—J. W. Carson, assistant director agricultural experiment station, College Station.

No institutes were held in Texas in 1907 owing to the failure of the legislature to provide funds for carrying on the work.

**UTAH.**

Institute director.—L. A. Merrill, superintendent of farmers' institutes, Salt Lake City.

Institutes were held in Utah during the past season, but owing to changes in the management it has been found impossible to secure data respecting the work.

**VERMONT.**

Institute director.—George Aitken, secretary State board of agriculture, Woodstock.

The Vermont board of agriculture is required by law to hold at least one meeting in each county during the year. The board has usually employed specialists in some branch of agriculture in addition to those of the Vermont Experiment Station and the agricultural college, to attend these meetings and deliver lectures. It has been the custom to take up for discussion such subjects as appeal to the general farming community, the growing of all crops suitable to the State, dairying, sheep raising, cattle feeding, the use of fertilizers and home-made manures. A general discussion of the topics presented is also encouraged, and this often brings to light the experience of some modest farmer present that is valuable. The attendance is usually good. There were held during the months of January and February, 1907, 34 institutes  
e attendance was 7,288.

The board has always been ably assisted by the staff from the Vermont Experiment Station, as well as by the State road commissioner, the secretary of the State board of health, also by members of the State tuberculosis commission, the State superintendent of schools, and private individuals. These lectures have always been cordially welcomed by members of the grange, and also by farmers generally. The State press has aided in giving publicity to the meetings, and as a whole the interest is gradually increasing.

#### VIRGINIA.

Farmers' institutes in Virginia are under the direction of the State board of agriculture, which is composed of a representative from each of the ten Congressional districts. Five hundred dollars is appropriated annually for institute purposes in each district, and is expended under the direction of the representative of the member of the district. There is at present no State director of farmers' institutes, the work being carried on by the individual members of the board. Reports have been received from but two of the districts, in which 7 institutes were held—6 one-day and 1 two-day, with a total number of sessions of 16, and an attendance of 310, at a cost of \$406.55. A State farmers' institute organization was organized four years ago at Roanoke, Va. This body is composed of representative farmers from all parts of the State, who meet in joint convention once a year and discuss the needs of agriculture and visit the agricultural college and experiment station at Blacksburg. A meeting was held during the past summer at Roanoke which was largely attended.

Owing to the Jamestown Exposition the energies of the members of the State board were turned in that direction, and consequently institutes, so far as can be ascertained, were held in only two of the ten districts of the State. An arrangement has been effected between the State board of agriculture and the agricultural and mechanical college at Blacksburg for the appointment of a farmers' institute director, who shall have his headquarters at Blacksburg, to take charge of the institute work of the State. No appointment, however, has yet been made.

#### WASHINGTON.

Institute director.—E. E. Elliott, professor of agriculture, State College of Agriculture, Pullman.

Twenty-four institutes were held in the State of Washington during the past season, composed of 70 sessions, with a total attendance of 5,250. The amount appropriated for institutes last year was \$5,000, but this did not become available until April 1, 1907. Thus for the greater part of the year no funds were available for institute purposes excepting during the months of April, May, and June. The legisla-

ture at its last session passed a bill approved March 16, 1907, appropriating to the agricultural college \$10,000 for the biennium ending March 31, 1909. The director of institutes is expecting to reorganize the entire system of institutes in Washington, with a view to making the meetings more directly beneficial to the farming interests of the State.

#### WEST VIRGINIA.

Institute director.—J. B. Garvin, secretary State board of agriculture, Charleston.

Farmers' institutes in West Virginia are under the control of the State board of agriculture. It is the duty of this board to look after and devise means for advancing the agricultural interests of the State, to promote and encourage as far as possible the holding of farmers' institutes, agricultural and horticultural societies, and other associations in the interests of agriculture in the several counties. The board appointed a State director to have immediate charge of the institute work, and appropriated last year \$7,476.71 for meeting the expenses. One hundred and ten institutes were held—106 of two days' duration and 4 of one day. The total number of sessions was 373, and the total attendance 24,825. An appropriation of \$12,500 was made to the board by the last legislature. Out of this sum the board appropriates for farmers' institutes so much as it thinks proper. A round-up meeting was held during the year, consisting of 14 sessions, but owing to the very high water that occurred at that time the attendance was only 75.

The institute director employed a lady instructor to lecture before the farmers' institutes, but no special women's meetings were held. The institutes in this State have been composed very largely of women and children; the presence therefore of women instructors qualified to teach these people the inexpensive improvements possible in household management, and particularly points with regard to sanitation, is of the utmost importance. Most favorable reports of the work of the women lecturers have been received, and the superintendent very strongly urges the continuance of the system.

#### WISCONSIN.

Institute director.—George McKerrow, director farmers' institutes, Madison.

An institute was held in every agricultural county in Wisconsin. The total number was 61, and all were of two days' duration excepting one, which extended over three days. The total number of sessions was 311, and the total attendance 49,989. The amount appropriated for institute purposes was \$12,000, and the total cost of the institutes was \$11,712.64. There was also received from advertising in bulletins \$643, and from the sale of bulletins \$128.09. A round-up

institute, continuing through 11 sessions, was held, with an attendance of 2,795. Women's institutes and six sessions of boys' institutes were held with satisfactory results.

A feature of the Wisconsin institutes is the publication of a State annual, a handbook of practical agriculture. There are printed each year 60,000 copies of this handbook for distribution at the institutes, rural clubs, cheese and butter factories, and by mail. The institute work of the State is under the control of the board of regents of the State university. The legislature of 1907 increased the appropriation for institute purposes from \$12,000 to \$20,000 per year.

#### WYOMING.

Institute director.—J. D. Towar, director agricultural experiment station, Laramie.

Eleven institutes were held, composed of 35 sessions, and having an attendance of 1,292 people. There were employed at some of these meetings six different men to deliver lectures on special subjects. These included two farmers from outside of the State, one dry farm expert from the State, the State food commissioner, and two professors of veterinary science from the Colorado Agricultural College.

The State legislature reenacted a clause in the general appropriation bill giving \$2,000 for the ensuing two years for the farmers' institute work, to be placed in charge of the trustees of the university, and carried on through the agricultural department. In addition, the legislature passed a general farmers' institute bill providing that the commissioners from each county can appropriate from county funds \$100, to be used in advertising and helping with farmers' institutes to be held by the university authorities in the several counties. This bill provides that there must be local county organizations for institute purposes.

The work is well begun and, considering the fact that there is only one person to each square mile in the State, the distance and lack of railroad facilities, and the small appropriation for the work, the results are quite satisfactory.



## STATISTICS OF FARMERS' INSTITUTES.

Number of institutes held and the approximate attendance during the year ended June 30, 1907.

State or Territory.	Number of one-day institutes.	Number of two-day institutes.	Number of three or more day institutes.	Total.	Total number of sessions.	Total attendance at all sessions.	Average per session.
Alabama.....	24			24	33	2,857	87
Alaska <sup>a</sup> .....							
Arizona.....	20			20	20	1,000	50
Arkansas.....	40			40	41	3,000	74
California.....	33	48	3	84	296	20,470	69
Colorado.....	44	17	1	62	171	16,960	99
Connecticut.....	37	1		38	74	9,522	129
Delaware.....	5	7		12	51	9,210	180
Florida.....	1			1	1	30	30
Georgia <sup>b</sup> .....							
Hawaii.....	1	1	1	3	6	500	83
Idaho.....			1	1	14	550	40
Illinois.....	8	57	46	111	589	333,350	566
Indiana.....	138	141	2	281	996	177,441	178
Iowa.....		85		85	340	51,000	150
Kansas.....	85	50		135	358	20,200	57
Kentucky.....		120	3	123	335	26,836	80
Louisiana.....	10			10	10	(c)	(c)
Maine.....	33			33	65	4,771	73
Maryland.....	6	15	2	23	121	9,833	81
Massachusetts.....	126			126	155	19,692	127
Michigan.....	262	63	4	329	965	115,136	119
Minnesota.....	138	1		139	282	67,063	238
Mississippi.....	146	2		148	296	17,945	61
Missouri.....	178	33	1	212	372	46,511	125
Montana.....	65	4	1	70	78	7,541	97
Nebraska.....	50	82	4	136	442	65,419	150
Nevada <sup>a</sup> .....							
New Hampshire.....	14	1		15	34	3,500	103
New Jersey.....	36	8		44	132	10,399	79
New Mexico.....	24			24	29	970	33
New York.....	80	129	2	211	834	105,196	125
North Carolina.....	124			124	246	31,980	130
North Dakota.....	5	19	1	25	99	9,709	98
Ohio.....		299		299	1,495	92,303	61
Oklahoma.....	18	22		40	99	6,715	69
Oregon.....	51	7		58	148	22,200	150
Pennsylvania.....	48	346		394	981	147,895	151
Porto Rico <sup>a</sup> .....							
Rhode Island.....	7			7	9	600	67
South Carolina.....	73			73	93	13,219	142
South Dakota.....	18	50	3	71	280	26,000	93
Tennessee.....	45		3	48	51	10,400	204
Texas <sup>a</sup> .....							
Utah <sup>b</sup> .....							
Vermont.....	34			34	68	7,288	107
Virginia <sup>c</sup> .....	6	1		7	16	310	20
Washington.....	20	4		24	70	5,250	75
West Virginia.....	4	106		110	373	24,825	66
Wisconsin.....		60	1	61	311	49,989	160
Wyoming.....	6	5	1	12	35	1,292	37
Total.....	2,003	1,784	80	3,927	11,514	1,596,877	4,913
Average.....						138.8	

<sup>a</sup> No institutes.

<sup>b</sup> No report.

<sup>c</sup> Report for two districts only.

*Financial statistics of the farmers' institutes for the year ended June 30, 1907.*

State or Territory.	Funds appropriated.		Cost.		Appropriations for the season of 1907-8.
	State.	College and other funds.	Total cost.	Cost per session.	
Alabama.....		\$600.00	a \$500.00	\$15.15	\$600.00
Alaska <sup>b</sup> .....					
Arizona.....	\$300.00		300.00	15.00	(c)
Arkansas.....					1,500.00
California.....	6,000.00		a 6,000.00	20.28	6,000.00
Colorado.....	4,000.00	1,003.19	5,003.19	29.25	5,000.00
Connecticut.....	1,900.00	535.57	1,365.00	18.44	400.00
Delaware.....	600.00	100.00	700.00	13.72	600.00
Florida.....		7.00	7.00	7.00	5,000.00
Georgia.....	2,500.00		2,500.00	(c)	(c)
Hawaii.....		62.05	a 62.05	10.34	
Idaho.....	142.08		a 142.08	10.14	1,000.00
Illinois.....	18,650.00	10,328.96	27,386.95	46.49	18,650.00
Indiana.....	10,000.00	2,700.00	12,700.00	12.75	10,000.00
Iowa.....	7,425.00		7,425.00	21.84	7,425.00
Kansas.....	3,000.00	1,064.00	4,064.00	11.35	6,300.00
Kentucky.....	13,000.00		a 9,334.59	27.86	13,000.00
Louisiana.....	2,000.00		a 500.00	50.00	2,000.00
Maine.....	5,000.00		5,000.00	76.92	3,000.00
Maryland.....	6,000.00		5,913.55	48.87	6,000.00
Massachusetts.....	2,750.00		a 1,575.77	10.17	4,000.00
Michigan.....	8,500.00	7,000.00	15,350.00	15.90	(c)
Minnesota.....	18,000.00	2,665.00	18,170.00	64.43	18,000.00
Mississippi.....	3,000.00		a 3,000.00	10.14	3,000.00
Missouri.....	5,000.00		a 5,000.00	13.44	5,000.00
Montana.....	4,000.00	1,000.00	5,000.00	64.10	7,500.00
Nebraska.....	6,000.00	2,684.04	8,684.04	19.64	10,000.00
Nevada <sup>b</sup> .....					
New Hampshire.....	1,600.00		1,600.00	47.06	2,000.00
New Jersey.....	3,060.98		3,060.98	23.19	2,500.00
New Mexico.....		1,900.00	1,900.00	65.51	800.00
New York.....	20,000.00		20,000.00	23.98	25,000.00
North Carolina.....	4,000.00	2,500.00	6,500.00	26.42	d 3,750.00
North Dakota.....	6,000.00		4,919.27	49.69	6,000.00
Ohio.....	22,000.00		a 19,882.77	13.29	22,000.00
Oklahoma.....		550.00	550.00	5.55	
Oregon.....	3,000.00		2,862.60	19.61	2,500.00
Pennsylvania.....	20,500.00		20,500.00	20.89	23,000.00
Porto Rico <sup>b</sup> .....					
Rhode Island.....	75.00		75.00	8.33	(c)
South Carolina.....	3,000.00		a 3,000.00	32.25	3,000.00
South Dakota.....	5,000.00		4,969.94	17.86	7,000.00
Tennessee.....	5,000.00		a 3,960.00	77.65	5,000.00
Texas <sup>b</sup> .....					
Utah <sup>c</sup> .....					
Vermont.....	5,000.00		1,811.89	26.64	5,000.00
Virginia <sup>e</sup> .....	2,500.00		406.55	25.41	5,000.00
Washington.....			(c)		5,000.00
West Virginia.....	7,476.71		7,476.71	19.63	12,500.00
Wisconsin.....	12,000.00	771.09	11,712.64	37.66	20,000.00
Wyoming.....	1,000.00		a 948.11	27.09	1,051.89
Total.....	248,479.77	35,970.90	261,849.68	27.93	285,076.89

<sup>a</sup> Not including the salary of the director.

<sup>b</sup> No institutes held.

<sup>c</sup> No report.

<sup>d</sup> For six months.

<sup>e</sup> Report for two districts only.

## Comparative statement of farmers' institutes.

State or Territory.	Appropriations.			Number of sessions.		Number of institutes.			Attendance.		
	1904-5	1905-6	1906-7	1905-6	1906-7	1904-5	1905-6	1906-7	1904-5	1905-6	1906-7
Alabama.....	\$600.00	\$600.00	\$600.00	85	33	24	35	24	3,820	8,590	
Alaska <sup>a</sup>											
Arizona.....	50.00	608.85	300.00	21	20	1	21	20	250	1,307	
Arkansas.....	400.00	400.00		42	41	30	31	40	7,650	7,150	
California.....	8,934.00	9,000.00	6,000.00	272	296	110	83	84	43,494	22,861	
Colorado.....		4,000.00	5,003.19	123	171	20	40	62	2,700	16,675	
Connecticut.....	428.00	1,825.00	2,435.57	83	74	14	24	38	1,200	4,895	
Delaware.....	750.00	725.00	700.00	40	51	18	18	12	4,199	7,200	
Florida.....			7.00		1			1			
Georgia.....	3,500.00	2,500.00	2,500.00	42	(b)	44	21	(b)	18,000	4,500	
Hawaii.....	35.00	33.45	62.05	8	6	4	3	3	350	300	
Idaho.....	1,000.00	1,000.00	142.08	105	14	25	21	1	4,000	7,875	
Illinois.....	20,960.39	30,281.53	28,978.96	667	589	100	108	111	69,759	79,428	
Indiana.....	10,000.00	12,500.00	12,700.00	918	996	250	250	281	79,964	129,894	
Iowa.....	7,425.00	8,096.06	7,425.00	402	340	60	69	85	18,000	66,959	
Kansas.....	2,000.00	2,000.00	4,064.00	522	358	55	155	135	11,453	27,300	
Kentucky.....	1,206.16	1,750.00	13,000.00	122	335	17	25	123	3,350		
Louisiana.....	2,500.00	2,000.00	2,000.00	44	10	67	22	10	14,541	2,657	
Maine.....	5,000.00	5,000.00	5,000.00	102	65	44	50	33	5,731	6,967	
Maryland.....	6,000.00	6,000.00	6,000.00	125	121	26	49	23	5,741		
Massachusetts.....	2,700.00	3,000.00	2,750.00	153	155	115	125	126	12,372	19,125	
Michigan.....	9,300.00	15,000.00	15,500.00	934	965	270	335	329	55,004	122,573	
Minnesota.....	18,000.00	20,238.40	20,665.00	238	282	105	105	133	52,125	51,211	
Mississippi.....	3,000.00	3,000.00	3,000.00	220	296	153	110	148	30,000	10,000	
Missouri.....	3,100.00	5,000.00	5,000.00	410	372	104	156	212	2,560	36,900	
Montana.....	2,500.00	5,000.00	5,000.00	133	78	47	71	70	6,946	7,890	
Nebraska.....	6,000.00	8,607.00	8,684.04	515	442	150	160	136	67,241	72,894	
Nevada <sup>a</sup>	379.00	(a)	(a)	(a)	(a)	10	(a)	(a)	665	(a)	
N. Hampshire.....	1,600.00	2,100.00	1,600.00	34	34	13	16	15	2,900	3,000	
New Jersey.....	1,838.15	3,000.00	3,060.98	116	132	30	40	44	5,538	11,611	
New Mexico.....	28.00	(a)	1,900.00	(a)	29	1	(a)	24	150	(a)	
New York.....	20,000.00	20,000.00	20,000.00	1,062	834	261	259	211	87,439	134,989	
N. Carolina.....	2,150.00	5,500.00	6,500.00	195	246	61	96	124	11,168	25,950	
N. Dakota.....	4,171.24	6,379.07	6,000.00	162	99	61	43	25	12,838	20,310	
Ohio.....	19,598.68	17,629.89	22,000.00	1,225	1,495	281	245	299	92,593	81,816	
Oklahoma.....		660.00	550.00	149	99	58	31	40	5,500	7,460	
Oregon.....	620.00	2,500.00	3,000.00	109	148	18	44	58	5,500	16,350	
Pennsylvania.....	20,500.00	20,500.00	20,500.00	987	981	196	226	394	150,932	165,553	
Porto Rico.....	(a)	(a)	(a)	(a)	(a)	(a)	1	(a)	(a)	50	
Rhode Island.....	100.00	100.00	75.00	2	9	1	1	7	400	300	
S. Carolina.....	1,194.56	4,524.40	3,000.00	74	93	33	54	73	7,460	11,149	
S. Dakota.....	(a)	6,500.00	5,000.00	119	280	(a)	59	71	(a)	10,000	
Tennessee.....	5,000.00	2,500.00	5,000.00	68	51	72	35	48	8,300	6,000	
Texas.....	3,850.00	540.00	(a)	35	(a)	110	27	(a)	8,500	4,500	
Utah.....	1,500.00	2,000.00	(b)	73	(b)	15	45	(b)	1,500	6,680	
Vermont.....	5,000.00	5,000.00	5,000.00	76	68	40	38	34	7,500	7,962	
Virginia.....	5,500.00	5,000.00	c 2,500.00	65	c 16	35	.....	c 7	8,000	19,500	
Washington.....	3,000.00	(a)	(a)	(a)	70	46	.....	24	7,282	(a)	
West Virginia.....	2,455.26	3,966.12	7,476.71	224	373	63	81	110	9,450	4,480	
Wisconsin.....	14,942.75	12,000.00	12,771.09	243	311	82	81	61	43,000	32,200	
Wyoming.....		1,107.59	1,000.00	64	35	1	11	12	75	3,401	
Total.....	225,738.89	269,672.38	284,450.67	11,409	11,514	3,271	3,521	3,927	995,162	1,299,172	1,561

<sup>a</sup> No institutes held.<sup>b</sup> No report.<sup>c</sup> Report for two districts only.

*Number of lecturers employed by the State directors of farmers' institutes during the year ended June 30, 1907.*

State or Territory.	Total number of lecturers on the State force.	Number of members of agricultural college and experiment station staffs engaged in institute work.	Number of days contributed to institute work by the agricultural college and experiment station staffs.	Total number of days of institutes held during the year.	Reports of proceedings.	
					Published.	Number of copies.
Alabama.....	12	16	64	24	No.....	
Alaska <sup>a</sup> .....						
Arizona.....	3	6	20	20	No.....	
Arkansas.....	6	7	7	40	No.....	
California.....	31	10	100	138	Yes.....	12,500
Colorado.....	22	16	81	81	No.....	
Connecticut.....	36	14	(b)	24	No.....	
Delaware.....	9	4	34	19	Yes.....	5,000
Florida.....	20	4	4	1	No.....	
Georgia.....	12	7	171	(b)	Yes.....	3,000
Hawaii.....	5	5	10	6	Yes.....	1,000
Idaho.....	12	5	25	5	No.....	
Illinois.....	107	30	250	260	Yes.....	20,000
Indiana.....	35	8	54	426	Yes.....	1,000
Iowa.....	14	15	(b)	170	No.....	
Kansas.....	28	15	304	185	No.....	
Kentucky.....	22	7	(b)	249	Yes.....	25,000
Louisiana.....	21	5	(b)	10	(b)	
Maine.....	27	3	7	33	Yes.....	6,000
Maryland.....	8	(b)	(b)	42	No.....	
Massachusetts.....	66	14	14	126	No.....	
Michigan.....	48	18	128	400	Yes.....	10,000
Minnesota.....	12	0	0	140	Yes.....	35,000
Mississippi.....	19	14	294	150	Yes.....	10,000
Missouri.....	26	11	(b)	247	Yes.....	10,000
Montana.....	21	13	205	76	Yes.....	5,000
Nebraska.....	33	21	703	226	No.....	
Nevada <sup>a</sup> .....						
New Hampshire.....	14	4	16	16	Yes.....	2,000
New Jersey.....	9	(b)	(b)	52	No.....	
New Mexico.....	11	3	143	24	No.....	
New York.....	61	20	190	344	Yes.....	15,000
North Carolina.....	26	5	80	124	Yes.....	30,000
North Dakota.....	8	2	42	46	Yes.....	10,000
Ohio.....	41	0	0	598	Yes.....	15,000
Oklahoma.....	7	3	(b)	62	No.....	
Oregon.....	14	2	200	65	No.....	
Pennsylvania.....	56	7	103	740	Yes.....	10,000
Porto Rico <sup>a</sup> .....	5					
Rhode Island.....	17	11	(b)	7	No.....	
South Carolina.....	14	16	(b)	73	No.....	
South Dakota.....	13	5	58	127	No.....	
Tennessee.....	9	4	48	54	Yes.....	3,000
Texas <sup>a</sup> .....						
Utah.....	16	(b)	(b)	(b)	(b)	(b)
Vermont.....	19	5	105	34	Yes.....	2,000
Virginia <sup>c</sup> .....	11	4	(b)	8	(b)	(b)
Washington.....	14	16	(b)	28	No.....	
West Virginia.....	31	3	(b)	216	No.....	
Wisconsin.....	23	1	1	123	Yes.....	60,000
Wyoming.....	10	7	96	19	No.....	
Total.....	1,084	386	3,556	5,858		290,500

<sup>a</sup> No institutes held.

<sup>b</sup> No report.

<sup>c</sup> Report for two districts only.

# THE RELATION OF NUTRITION INVESTIGATIONS TO QUESTIONS OF HOME MANAGEMENT.

By C. F. LANGWORTHY, Ph. D., *Nutrition Expert.*

## INTRODUCTION.

The nutrition investigations conducted for some twenty years under the auspices of this Office, broadly speaking, have had for their object the study of the utilization as human food, of dairy products, cereal crops, fruits, and other agricultural products, and the investigation of problems which pertain to this general question. These investigations have furnished a great deal of information along a number of lines which are included in the general subject of home economics, and many facts which are of value in the consideration of many of the more important home problems.

No enterprise can be carried on to advantage unless it is based upon well-established principles and is conducted in a systematic manner, and this applies to the home as much as to a commercial enterprise. The knowledge gained by experience and handed down from mother to daughter is, in the majority of cases, the only guide which the housekeeper has in solving her food problems and other questions; yet it is true that valuable as such empirical knowledge is, it is not sufficient for the requirements of the modern home. For these reasons, and for many others, it is essential that accurate studies of home problems should be made, in order that household practice may rest on a basis of demonstrated fact.

The solution of the problem of the most satisfactory use of the available food supply necessitates a knowledge of the relative nutritive value of farm products and other foods, and this question has been studied as well as methods of handling and storing food in the home, the preparation of food for the table, and the relation of food to body demands as influenced by age, sex, and muscular activity. Such topics are of the utmost importance in any intelligent study of the home problem, as are many other questions which have been studied in connection with the nutrition investigations. The results already obtained are numerous and capable of general application, and it has been clearly shown that it is possible to so apply available information that burdens incidental to the food problem in the home may be lightened and the daily fare made more attractive and better

suited to the family needs, while from a financial standpoint a considerable saving is often possible since intelligent management means less waste and needless expense.

While much has been accomplished, there still remain many important questions whose solution is essential if the best use is to be made of available resources and home conditions are to more nearly approach the ideal. This need for research and accumulation of data, which will help to make the most necessary factor in home life, viz, the feeding of the family, conform more nearly to the demands of physiology, hygiene, and true economy, is not peculiar to home making, the oldest of the industries, but is a condition which has been found to exist also with respect to most manufacturing and commercial enterprises. The weaver in early times learned at home all that he required for the practice of his art, which was essentially a home industry. Before this art developed into a great manufacturing enterprise it was necessary to solve countless problems which could only be approached by laboratory methods. At the present time the problems of the home maker bear about the same relation to housekeeping in early times as does the modern textile industry to the primitive loom. The value of systematic investigation and the application of exact knowledge are as great in one case as in the other.

The interest in the scientific study of home problems is a growing one, as is shown, for instance, by the important place such problems occupy in the programmes of women's club work, in the popular press, in farmers' institute and university extension work, in the plans of settlement workers and similar organizations for home betterment, in the extension of courses in home economics branches in schools and colleges, and the recognition of such lines of work as possessing true educational value, and by the increasingly large number of trained investigators in agricultural colleges, medical colleges, universities, State boards of health, and similar institutions, who are giving their attention to the solving of the many complex problems pertaining to food and nutrition.

#### **COLLECTING AND DISSEMINATING INFORMATION.**

In connection with the nutrition investigations of this Office a large fund of information has been collected regarding the relative value of different foods produced on the farm, ranch, and garden, and the effect on nutritive value of milling and other manufacturing processes; the comparative digestibility and nutritive value of different foods; the effect of methods of cooking upon palatability, nutritive value, and digestibility; the relative merits of different methods of combining foods to secure a rational and palatable diet; the comparative economy of different methods of cooking and preparing foods; the

effect of different methods of storing and handling food in the home on palatability, wholesomeness, and nutritive value, and on related questions. As a result of these investigations some 60 technical bulletins have been prepared reporting the details of the experimental work, as well as some 35 Farmers' Bulletins and similar publications, in which the practical results and general information along similar lines are set forth in such a way that they may be useful to home makers and others interested in general questions of food nutrition and home management. That the technical bulletins are appreciated is shown by the demand which is made for them by investigators in the United States and elsewhere, and by the extended use which is made of the results reported by writers of text-books, and reference works, and by scientific workers in general. That the popular bulletins are used extensively by the people is shown by the fact that 3,000,000 copies of the 16 Farmers' Bulletins on nutrition topics now available have been distributed, and it should be said in this connection that these publications are not sent out broadcast, but are distributed only on request.

The Office of Experiment Stations is a clearing house for the results of investigations on all lines relating to agriculture, the farm, and the farm home. As an integral part of the regular work of the Office, publications of agricultural colleges and experiment stations, and reports of the work of many investigators outside of these institutions, at home and abroad, are examined, and abstracts of such as are related to agricultural subjects are published in the Experiment Station Record, or used in other ways so that they may be generally available for investigators and practical workers interested in agriculture and agricultural science. No one would question the fact that the scientific journals and similar publications, which are seldom seen by the farmer, contain information which would be of value if brought to his attention, and it is equally true that the publications referred to contain data of value to the farmer's wife and to the home maker in country or town, as well as to the teacher of food and nutrition and other branches of domestic science and domestic art.

It has long been the custom in connection with the nutrition investigations of this Office to collect information from the sources referred to, and data suitable for the purpose have been published in the Experiment Station Record in the form of abstracts. In many cases information thus collected, believed to be of general and popular interest, has been published in the series of Farmers' Bulletins entitled "Experiment Station Work." In other cases the data have been properly classified and filed for future reference. Information thus collected and systematized has proved to be of the greatest use in answering the numerous letters which are received requesting information on a wide variety of home topics when such requests

can not be adequately met by supplying Farmers' Bulletins and other published data.

The central idea in collecting this information in connection with the nutrition investigations has been "food and diet" in the broadest sense of the term, but the fact has been recognized that food is only one factor in home life and that all the factors are closely related, and so information along other lines has been included as opportunity offered, and the total amount now available on the general subject of home management is large. The information thus gathered is essential to a broad survey of what is being done in the whole subject of home life and home betterment in this country and abroad, as well as in the restricted field of human nutrition. The effort to collect and systematize knowledge has also proved useful in another way, for it has shown where to look for information along different lines connected with home problems and has made it evident that the amount of data which can be gathered on these subjects, and which should be the basis for all future work, is very great; in other words, in connection with the nutrition investigations a system of collecting and compiling data has been devised which there is every reason to believe will give as good results in the broad field of home life and home betterment as it has given in the more restricted field of human nutrition.

#### **VARIETY IN THE DIET AND THE WAYS OF OBTAINING IT.**

Variety in the diet is commonly conceded to be a desirable characteristic. Formerly variety was justified largely on æsthetic grounds. Modern physiological and chemical research has shown that it bears an important relation to digestion and assimilation and can be justified on scientific grounds as well. The farmer's wife, who wishes to secure variety for her table, has a different problem to meet from her sister in town, and in some ways the advantage should be on her side, as she almost always has milk, cream, butter, and eggs in abundance and should have an abundance of vegetables and fruits as well. Maple sugar, maple sirup, honey, and many other articles which are luxuries in town are readily obtainable on the farm, if indeed they are not products of home manufacture. On the other hand, the farmer's wife has not at her command the varied food products of the city dealer in meats and provisions or the baker or confectioner. She can, however, from the materials at hand, and without undue labor, provide attractive and satisfactory food for her family if she can be made to appreciate the variety which is obtainable by different methods of preparation and combination and the relation of characteristic flavor foods to those which, though of equal or of greater nutritive value, have a less distinctive taste. To cite a homely instance which illustrates this point, it is the small amount of butter and jam which



transforms the child's slice of bread into something which is highly prized. The principle holds good through the whole range of family or group dietetics. It is this principle which necessitates the use of flavoring vegetables or well-made sauces if the tough cuts of meat which require the long, slow heat of boiling to render them tender are to be made as palatable as the juicy steaks and chops of entirely different texture, which may be quickly and easily cooked. It is the combination, in proper proportion, of foods and dishes with distinctive flavor with those which are less distinctive which is the underlying principle of good management of the home table.

In past years it has frequently been the custom to secure variety by the use of great quantities of jams, pickles, cake, and pastry foods, whose use in excess is not conducive to health or right living. The extensive studies which have been made of problems relating to food and nutrition have shown that there are other and better ways which entail less burden on the housekeeper. Some of these questions of home management have already been discussed in nutrition publications. Other questions it is proposed to discuss in similar bulletins in the future, if opportunity offers.

#### THE PREPARATION OF FOOD IN THE HOME.

Everyone knows that there is more or less waste in preparing and cooking food. In connection with nutrition investigations this question has been studied, and the loss of nutritive material has been measured for a great variety of foods under many different conditions. The results of such studies are important and can be so presented to the housekeeper that she may make use of them in ways best suited to her individual needs. It is obvious that small savings on individual items is a matter of greater importance in the feeding of a large group than with a small family, but in both cases a rational use of resources is generally desired and can be secured if the various factors which enter into the problems are rightly understood. The cause of storeroom, kitchen, and table losses and ways of avoiding them have been studied, and the food value of material saved with relation to the original cost of the material and the labor involved in avoiding losses has not been overlooked. Although additional information is desirable on this, as on many other questions of nutrition relating to home management, it is possible, with the data on hand, to show the housekeeper improved methods of using her available food supply in an economical and satisfactory way, and how, in many respects, she may reduce kitchen and table waste to a minimum.

Another illustration of the ways in which results of studies of nutrition problems may be applied in the home is afforded by the data obtained in studies of bread and bread making. It is generally be-

lieved—and the opinion has been confirmed by investigations carried on in a number of localities in the United States—that, although there are many instances where good bread is the rule, there are far too many cases in which it is not even of fair quality and where homemade bread never passes the experimental stage, good or bad bread being largely a question of “luck.” Bread making is a part of household work involving a considerable amount of labor, which in many towns and cities has been largely eliminated from the home and which has become a commercial enterprise, and it is important that the housewife in rural regions should realize that it would be possible for her to cooperate in her baking, as indeed she might in her laundry work and in other household tasks which are time-consuming and burdensome, in the same way that she now cooperates in her dairy work and very generally transfers this household burden to the creamery. Under present conditions, however, bread for the majority of homes costs less if homemade than if purchased, and if it is to be made at home it should unquestionably be of good quality, yet should not involve undue labor.

The studies carried on under the auspices of this Office on the methods of bread making, the losses involved in fermentation and other bread-making processes, the relation of temperature and fermentation to the quality of bread, and related matters have furnished valuable data for the housekeeper, as have the studies of the nutritive value and digestibility of bread made in different ways from different grades of flour. On the basis of this work and other available data correct methods of bread making have been formulated, and the housewife can be told how to make uniformly good bread without undue labor if she will abide by certain well-established principles. The proportion of yeast to a given quantity of flour is one of the important considerations, especially with reference to the time the dough must rise. For instance, if the housewife is compelled to make bread quickly, she should apply methods which expert bakers use and increase the proportion of yeast as she diminishes the time of fermentation. Many housewives believe that bread should be kneaded for a long time in order that the loaves may be of proper consistency. Investigations have shown that excessive kneading is wasted labor, and that by proper manipulation of the dough bread possessing all the desirable characteristics may be made without undue expenditure of time and energy. Bread-making machines have been in use in bakeries for years, but for a long time were too large or too expensive for home use. This is no longer the case, and experience has shown that some of the bread-making machines for domestic use which are now on the market will give good results.

In making biscuits, cakes, etc., the principle that if a little is good more is better is often applied in the use of baking soda and similar

leavening materials, and the product is spoiled instead of improved. The proportion of such leavening agents needed, and other questions relating to quality of the product, have been studied and data are available which make the use of such material questions of exact measurement, not of accident or luck. Here, as elsewhere, the scientific principles which underlie kitchen problems have been found out by laboratory investigations. When once the fundamental principle and the physical and chemical processes involved are thoroughly understood, it is possible to formulate simple rules for the housekeeper's guidance which are of wide application and which do much to make problems of home management questions of exact science. The housekeeper is too often like the miller of primitive times, who pounded his grain with the mortar and pestle, when she might be like the modern miller, who grinds his grain with all the modern appliances which ingenuity and skill have devised.

#### **FOOD AND ITS PREPARATION IN RELATION TO HYGIENE.**

The relative ease of digestion of different foods, the relation of household methods of handling, storing, and preparing food to wholesomeness and quality, and questions of a similar nature which bear upon household hygiene, have been studied in connection with the nutrition investigations of this Office. Although of necessity the experimental studies which have been carried on have been confined to persons in health living under normal conditions, many of the results, particularly those which have to do with relative food values, with questions of digestibility, methods of preparing foods, and so on, furnish information of great importance and value in considering dietary questions with reference to the needs of the sick and convalescent.

To cite an instance of the way in which scientific investigations may help to an understanding of everyday problems, the question of fried food and the bad name which so generally attaches to it and which is usually attributed to an excess of fat, may be cited. In this method of preparing food heat is applied for a short time only and is usually intense. When fat is overheated it decomposes, and an irritating body called "acrolein" is formed, which attacks mucous surfaces and is very unpleasant in its action. This body is formed as readily in the kitchen as in the laboratory, and there is reason to believe that when disturbances come from eating fried foods they are more often attributable to bad methods of cooking than to the process itself. While it is undoubtedly true that good methods may be formulated on the basis of experience and observation, it is equally true that it is easier to fix upon a rational household practice when the principles involved are thoroughly understood.

To cite another instance: It is very commonly said that cabbage is indigestible, and, consequently, an unwholesome vegetable. A careful study of the problem shows that this opinion is not deserved, provided the cabbage is properly prepared. To be palatable and wholesome, it is essential that this vegetable should not be overcooked; it should simply be cooked until tender, and no longer, for some of the constituents of cabbage apparently undergo decided changes when submitted to the action of heat for any considerable time. These changes in chemical character are accompanied by changes in color, the white portions of the cabbage becoming first yellowish and then brownish, while the green portions lose their characteristic color and also become yellow or brown. Some of the cleavage products formed when cabbage is boiled are volatile and contain sulphur, and if retained in the cooked product apparently may be the cause of digestive disturbances. It is obvious, therefore, that in order to be wholesome, cabbage thus cooked should be thoroughly ventilated, and, furthermore, should not be cooked until it has become yellowish or brownish in color. If cabbage has been overcooked with fat meat of some kind in such a way that each small portion of it is coated with a layer of liquid fat it is even more likely to prove irritating to the digestive tract, particularly for persons who have little physical exercise.

A complete understanding of these questions takes one far into chemistry, physiology, and hygiene, and yet such an understanding of them is essential for the teacher and the investigator if household practice is to rest upon the soundest basis. However, when the fundamental facts have been learned and applications have been deduced from them, the results can be presented to the housekeeper in such a way that her processes will be rational and correct and her dishes palatable, while at the same time she need not be burdened with all of the technical details.

#### HOME CONVENIENCES AND RELATED PROBLEMS.

Information has been accumulated in connection with the nutrition investigations regarding some of the topics which are ordinarily included in the subject of domestic arts, although the circumstances under which the enterprise has been carried on did not warrant any extensive study of these questions.

The development of household conveniences and improvement in their construction is not at all comparable with the progress which has been made in the construction of farm machinery and other labor-saving devices for man's work. Yet it is as important that the housekeeper should have the benefit of labor-saving devices as it is that the farmer should use reapers, binders, and other modern farm machinery. The work of the woman in her home is frequently harder, in propor-

tion to her strength, than that of the man, and every effort should be made to lessen her burdens by proper house construction and by the use of labor-saving devices. In connection with the nutrition investigations a considerable fund of information has been gathered along lines which bear upon such questions as the above, particularly the relative value of different methods of carrying on different kinds of home work.

Ventilation is one of the very important problems in household construction, and experiments which have been made with the respiration calorimeter have made a valuable contribution to this subject. The carbon dioxid content and temperature of the air, and the proportion of oxygen which is supplied, were studied under a variety of conditions, and from the results obtained it would appear that the discomforts of insufficient ventilation are more dependent upon the humidity and temperature of the air than they are upon an accumulation of carbon dioxid. The very promising results obtained so far make it plain that information of the greatest value could be readily accumulated by means of experiments with the respiration calorimeter, provided such questions were systematically studied. This apparatus also provides the most accurate means yet known for studying the protective power of clothing and of textiles used for other household purposes, and some information has been accumulated along these lines in connection with experiments undertaken for different purposes. The data gathered are too few for general deductions, but they are sufficient to show the possibilities of the apparatus and experimental methods when applied to household problems of this character.

The comparative cost of different fuels with special reference to their use in the preparation of food is a very important question in home management, and some information has been collected along these lines also in connection with the nutrition investigations, though experimental work has not been undertaken. A study of such problems would of necessity involve the use of the bomb calorimeter and other experimental methods which have been devised in connection with the nutrition enterprise, and studies could be readily undertaken should opportunity arise.

Information has also been gathered regarding the comparative cost of different methods of performing household labor and related topics and regarding available labor-saving devices and their use in the home.

Data have also been collected regarding the household water and ice supply, the disposal of garbage and other refuse, and regarding the planning and constructing of the home, in order that it may be convenient and not require undue labor for taking care of it.

As has been said, of necessity any work along the lines mentioned above has been carried on incidentally, and not as an integral part of the nutrition investigations. What has been done has, however, shown the possibilities of profitable work of the greatest importance to all interested in home management and made it plain that apparatus and experimental methods already devised and used in the study of nutrition problems can be readily adapted to include the study of many other important questions related to the home.

#### **IMPORTANCE OF IMPROVED LIVING CONDITIONS FROM AN ECONOMIC STANDPOINT.**

Wage-earners and families whose income does not exceed \$1,000 per annum unquestionably constitute one of the largest groups of our population, and a group whose importance to the country as a whole is second to none from a sociological and economic standpoint. According to statistics recently summarized by the Bureau of Labor of the Department of Commerce and Labor, 45 per cent of the total annual income of small wage-earners in the United States is expended for food. That this large proportion, representing nearly half of the entire income of the family, is wisely expended in all or even in a majority of cases no one familiar with usual living conditions would insist. There is no doubt but that the general dissemination of knowledge regarding such questions as the relative nutritive value of different kinds of food, proper methods of preparing and serving it, and the demands of the body for food under different conditions would enable the great army of housekeepers to supply a better and more rational diet of improved quality and at a less cost, and that the application of knowledge pertaining to food and nutrition of the sort which has been gathered in the nutrition investigations would add to the pleasure and comfort of these families, as well as to their material prosperity. That this is so has been the testimony of many individuals who have made the effort to apply such knowledge to home conditions, and is also shown by the readiness with which the results of nutrition investigations are used by teachers, by philanthropic and charitable organizations, by sociological workers, by intelligent housewives, and, indeed, by all who are interested in the great problem of home betterment.

#### **HOME BETTERMENT.**

The nutrition investigations of the Department have been confined very largely to the study of questions which relate to the right nutrition of man under a variety of circumstances, and to the comparative nutritive and economic value of foods and related topics; yet the bearing of the work upon the broader question of home betterment and the

welfare of the family has always been recognized. Of necessity a considerable amount of sociological data has been collected, because it was felt to be essential to the right interpretation of the results of many of the investigations carried on in homes in different parts of the country. In discussing results of dietary studies and other investigations in rural regions and in towns, and the studies of existing conditions and possibilities for improvement, it has been made clear that the problem of home betterment is absolutely bound up with the question of food supply and its preparation. If the housewife is to find time for rest, for recreation, and for a broader outlook on life, she must, in the majority of cases, also find some way of lightening her household burdens, and almost always this means she must find some way of lessening the labor required to prepare the food for her family and for similar tasks. Very often it also means that money can not be provided for the betterment of the home unless the necessary living expenses can be lessened. In many instances a careful study of the situation has made it evident that with a wiser use of available resources an equally nutritious and a much more palatable diet could be provided at less expense and with less trouble. If the housewife can be shown how she can eliminate the nonessential, if labor-saving devices and improved methods can be brought to her attention, and if she can be taught how to apply most effectively the results of experiments and experience, it is certain that her household labors may be lessened and that more time may be available for other things.

A careful study of the results obtained in the nutrition investigations of this Department and other enterprises of a similar nature leads to the conclusion that although there is great need of additional investigations, we now possess a fund of information which, if rightly used, would do much to bring about the better conditions of home life which are so desirable. The important bearing upon home life of the results of dietary studies and other nutrition investigations is apparent from the way in which the results have been utilized by settlement workers and others who are interested in the living problems of the great army of wage-earners in cities and towns and by teachers. In the same way farmers' institute workers, members of clubs for home study, and of women's clubs (and the club movement has grown until it has become a great factor in rural regions as well as in towns), and others who are trying to bring about improved conditions in woman's life in country and town have been among those who have been most appreciative in their use of the results. Indeed, it may be said that in this country, and very frequently in other countries also, individuals and societies who work for social betterment have turned to the nutrition investigations of the Office of Experiment Stations for information, advice, and assistance, since they

have recognized that a knowledge of existing conditions and information regarding food and nutrition problems is of the utmost value in formulating plans for the improvement of conditions with families of small means, where "half the struggle for life is the struggle for food."

### EDUCATIONAL WORK IN HOME ECONOMICS.

The work which is being done by women's colleges and similar institutions to train the farmer's daughter and the daughters of other American homes along lines of home management should not be overlooked. An exhaustive inquiry into the subject shows that there are in this country some 200 institutions of collegiate grade which give training in domestic science, domestic art, or both. Many of these institutions are agricultural colleges, and a fair proportion of the whole are located in small towns. The rural regions have always contributed their full quota to the student body of our American educational institutions, and the women's colleges and other institutions for higher education carry on their rolls a very large number of farmers' daughters. Furthermore, these institutions and the normal schools, which also are now very commonly offering instruction in domestic science and domestic art, train the women to teach in the rural region as well as in the town. That this great body of trained women carry information directly to the home by training the children—the home makers of the next generation—is a factor which should not be overlooked in considering the possibilities of bettering the conditions of home life. The Office of Experiment Stations is in close touch with these educational institutions, and in the majority of them the nutrition publications of the Office are in constant use for class-room purposes.

### CONCLUSION.

Studies of food and nutrition are fundamental to the solution of the problems of home management in country or town. It seems fair to say that the nutrition investigations of the Office of Experiment Stations have developed methods of study and investigation, the value of which is widely recognized and used in solving home problems, and have made a contribution to the fund of available information which is generally conceded to be very great in scope and extent and of decided value from a practical as well as from a scientific standpoint.

It is not the purpose of those who are interested in the study of nutrition problems to regulate household management according to any prescribed formula, but rather to furnish data regarding the nutritive value of different foods and food products, their digestibility, the ways in which they may be most satisfactorily handled, stored, and cooked in the home, and related questions, so that the



housekeeper may have accurate data regarding the materials she uses and may be able to apply the same intelligence to the solution of her home problems which the successful manufacturer or business man applies to his work. The nutrition investigations have yielded information of great importance and value in connection with these home problems, and it is not too much to say that while many questions remain for future study, it is now possible, on the basis of available information, to make practical suggestions suited to individual needs or of more general application, which would result in a more adequate and satisfactory diet and a better utilization of available food resources without entailing undue expense or effort on the part of the housewife.



# LOSSES OF IRRIGATION WATER AND THEIR PREVENTION.

By R. P. TEELE,

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## INTRODUCTION.

Under present practice a very large part of the water diverted from streams for irrigation is lost by seepage from ditches, by evaporation from ditches and from the wet surfaces of irrigated fields, by percolation beyond the reach of plant roots, and by wasteful practice. However, this loss of water differs from the waste of other natural resources in that water must be used as it comes. Waste in one season does not produce a future shortage, and present saving does not increase the supply for the future. For this reason the prevention of losses of irrigation water is almost wholly a question of present cost and value. Prospective value due to increasing demand can not lead to hoarding; in fact, under our present system of water rights it leads to waste, since water users deliberately use more than is necessary or even waste water in order to establish claims on future supplies, producing the curious anomaly of present extravagance resulting in future wealth, from the standpoint of the individual. This brings out the fact that the loss of irrigation water has two phases, the physical and the institutional. Therefore any comprehensive study of the subject must include not only measurements of losses and experiments in preventing them, but investigations of the influence of laws and regulations upon the quantity of water used or wasted.

Since there is water enough for only a small part of the land suitable for irrigation, it follows that any avoidable loss or waste limits by just so much the area which can be watered ultimately. The limit of the water supply has not been reached in all sections of the arid regions, but as it is approached the prevention of losses becomes more and more important.

The limiting of the area irrigated is not the only bad result of losses and excessive use. The water wasted has swamped large areas once fertile or brought up so much alkali as to injure or destroy vegetation, requiring drainage or the abandonment of the land.

A further disadvantage is the increased cost of irrigation due to building works large enough to divert and transport large quantities of water which not only serve no useful purpose but do positive harm.

### LOSSES FROM CANALS.

From the beginning of the irrigation investigations of this Office to the present, measurements of the losses from ditches have been made. The measurements are of the greatest value to the owners of the ditches measured, since they locate the losses and make it possible to improve the sections of channel which lose most, but the averages make a valuable basis for estimating the increased size which must be given canals to carry the water lost, the expense which may be incurred to prevent losses, and the possible extension of the irrigated area by preventing losses.

The highest loss found was 64 per cent of the water entering the ditch in a single mile of ditch, while other canals having canals or irrigated lands above them showed gains. Averaging the measurements from all the canals included and grouping them according to size gives the following results:

*Average losses of water from canals by seepage and evaporation, by groups.*

Size of canal.	Average.	Loss per mile.
		<i>Per cent.</i>
Canals carrying 100 cubic feet or more per second.....	13	0.95
Canals carrying between 50 and 100 cubic feet per second.....	15	2.58
Canals carrying between 25 and 50 cubic feet per second.....	15	4.21
Canals carrying less than 25 cubic feet per second.....	24	11.28

The average for the large canals is approximately 1 per cent per mile.

A commonly accepted estimate of the loss from large unlined canals is 30 per cent of the water taken in at the headgate, and from the measurements given this seems to be conservative. It is probable that as much or more is lost from the laterals and field ditches, so that it is well within the truth to say that not more than one-half the water diverted by the average unlined earthen ditch reaches the fields for which it is diverted.

### PREVENTION OF SEEPAGE LOSSES.

It is evident that these losses can be prevented by carrying the water in pipes, and very nearly stopped by lining canals with cement concrete or cement plaster, and as the magnitude of the losses is better appreciated and the value of water grows an increasing part of the water supply for irrigation will be carried in this way. But at present these means are too expensive for most places and most crops. The real problem of reducing losses is to bring the cost within the limits allowed by the value of the water saved or to increase the net returns due to the saving by decreasing the cost still further. In

southern California, where water is scarce and the value of products high, seepage losses have been almost eliminated by lining the main ditches with cement concrete or plaster and distributing the water to the fields in underground pipes, and other less expensive linings have been tried there and elsewhere.

To determine the effectiveness of these linings this Office, in cooperation with the University of California, carried out a series of experiments.<sup>a</sup> Pits similar to canal sections were made and lined with the substances to be tested, while similar pits were left unlined for purposes of comparison. The following table shows the efficiencies of the various linings expressed in percentages of saving of the loss from the unlined pits:

*Effectiveness of ditch linings.*

Description of lining.	Saving.	Experimental cost of lining per square foot. <sup>a</sup>	Actual cost of lining per square foot. <sup>a</sup>
	Per cent.	Cents.	Cents.
Cement concrete, 3 inches thick.....	86.6	8.30	7.50
Cement lime concrete, 3 inches thick.....	65.5	8.30	7.50
Cement mortar.....	63.3	3.88	3.25-3.50
Heavy oil, 3½ gallons per square yard.....	50.4	1.20	1.20
Clay puddle, 3.5 inches thick.....	47.8	3.90	1.20
Heavy oil, 3 gallons per square yard.....	38.0	1.00	1.00
Heavy oil, 2½ gallons per square yard.....	27.3	.77	.77
Thin oil, 2.5 gallons per square yard.....	7.3	1.00	.80
Earth (no lining).....	.0		

<sup>a</sup> Excluding the preparation of the ditch.

While there is no doubt that cement concrete is the most effective as regards seepage, it is also the most expensive, the cost being more than six times that of the heavy oil lining (3½ gallons per square yard), which saved 50.4 per cent of the water which would have been lost were the ditch not lined, while the saving with the concrete ditch is 86.6 per cent, or only one and three-fourths times as large. Where water is very valuable there is no doubt but that the concrete ditch is more permanent and economical. But where the water is not so scarce and a little waste will do no damage, the expense of lining the ditch with oil may be justified, while a more expensive lining would be impracticable.

A large number of canals in southern California have been lined with cement concrete, cement plaster, and masonry, and various combinations of these. These are described, with data as to cost, in the bulletin containing the results of the experiments just discussed. The methods of putting the linings in several of the canals are described below.

<sup>a</sup> See California Sta. Bul. 188.

The method of construction used by the Bear Valley Water Company is as follows:

The ditch is excavated to a cross section of such size that after receiving the lining it will be the desired size. Forms are used and between the forms and the sides is a space the thickness of the lining. Into this space a layer of cobbles is built, with the interstices filled with small stones; a grout formed of one part of lime to seven parts of clean, sharp sand is then poured in and tamped, in order to fill all voids. The lining of the sides is built up in this manner in consecutive layers, 1 foot at a time. The bottom is usually paved before the sides, the form resting on the bottom. The lining is generally allowed a few days to harden; then the forms are removed and the cement plaster put on. This plaster is a mixture of one part cement to three parts of clean sand, and is applied about one-half inch thick, giving a smooth surface.

The Crafton Water Company used no form. The sides and bottom were put in by line, the cobbles being placed to line and grade in lime mortar, the interstices between cobbles being filled and chinked. The surface was evened off by forcing in cement mortar with a trowel, and a coating of thin cement mortar about one-half inch thick covered the sides and bottom. The rock lining was about 1 foot in thickness. This work was done in 1893, thirteen years ago, and was limited to the intake canal (1 mile long) of the Crafton Water Company. According to one of the former directors of the company no repairs have been made during these thirteen years. The work is still in good condition. The average cost of this class of lining would probably be about 13 cents per square foot.

The Hemet Land and Water Company used the following method: The canal was excavated with scoop scrapers and shovels. No form was used in the excavation, the cross section being finished, ready for the lining, by the shovelers. After the excavation, the banks were well moistened by letting the water into the excavated canal and holding it by earth dams. When the banks were thoroughly wet the water was drained out and the lining put on. The lining consists of cobbles, most of them not less than 6 inches in dimension, placed in the cement mortar. The bottom was constructed first, the cobbles being laid in the bed of cement mortar and the space between cobbles well filled in and finished smooth and to grade. This cement mortar for the bottom consisted of one part of cement to four parts of clean river sand. A little lime was added to this mortar. Closely following the lining of the bottom came the lining of the sides. (Fig. 29.) For this, mold frames and moldboards were used. The frames were placed 5 feet apart and so constructed that the moldboards were held in place against the frames by a  $\frac{3}{8}$ -inch iron rod. The moldboards

could be put in one at a time, and one section 20 feet in length was finished at one time.

The mold frames having been put in position and the lowest mold-board placed on each side, a layer of cement mortar was spread on the bottom; in this mortar were embedded cobbles, another layer of mortar put on top of these cobbles, then successive layers of cobbles and mortar until the side lining was completed for the section. Mold-boards were put on as the lining was built up. The mixture was also tamped during construction to assure the filling of all spaces between cobbles. The ingredients used for the mortar in this lining of the sides were one part of cement to six parts of river sand. After the forms were removed the sides and bottom were finished with a very thin wash of neat cement.

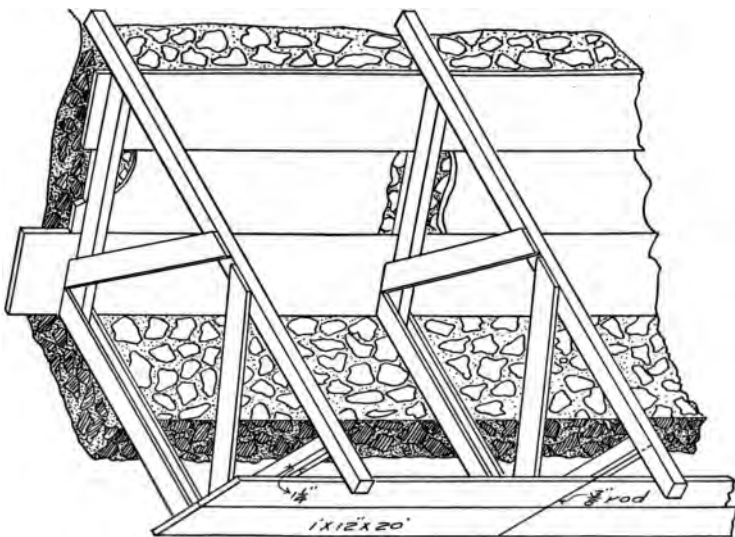


FIG. 29.—Method of lining the Hemet Land and Water Company's canal.

The Anaheim Water Company has lined its main canal and laterals with concrete varying in thickness from 4 inches for the larger canal to 2 inches for the smaller laterals. The work of lining has been done very thoroughly and with great care. If the canal is an old earth ditch, it is prepared for the lining and carefully finished as described below. If the canal is to be constructed and then lined, the excavation is made with shovels, or with teams where more economical, the excavation being generally preceded by a thorough irrigation to settle and soften the ground. The excavated cross section is made larger than the finished cross section by the thickness of the lining. The bottom of the ditch is carefully graded and tamped, so as to give a solid, smooth surface. A wooden form is placed on the bottom of the excavated ditch. This wooden form is a trapezoidal trough with no

bottom, 16 to 20 feet long, depending on the size of the ditch; to make it rigid the frames on which the side moldboards are nailed are placed every 2 feet. Moist earth from the excavation is shoveled behind this form and is well tamped in successive layers; at least 6 inches of earth on each side is packed solidly in this manner. The form is then removed and before the earth has had time to dry the lining is put on. For the lining another form, smaller than the first, is used. The depth of the form is equal to the depth of the lined section plus the thickness of the concrete. It is placed on the bottom of the finished earth ditch and properly aligned; the concrete, which is mixed rather wet, is thrown in the space between the form and the earth and well tamped. The side lining having been completed, the form is removed and the bottom lining put on. Wherever possible the concrete is kept wet while setting by allowing water to run in the ditch and holding it by earth dams. The concrete is made of one part cement to seven parts of coarse gravel of varying size.

The Gage Canal Company, the Riverside Water Company, and the Jerupa Company have used cement plaster extensively. The lining usually varies from one-half to 1 inch in thickness. Various methods are used in preparing the canal for the lining and in applying the lining.

The method used, as described by the late Mr. Irving and supplemented by information given by Mr. Mylne, the present engineer of the company, is as follows:

The grade stakes were located on the banks at a given distance from the top of the sloping sides, usually 1 foot. These grade stakes were spaced at intervals of 20 feet. A level rod or cross-section rod of sufficient length to reach from one bank to the other was held at right angles to the ditch, with one end on the grade stake and the corresponding stake set on the other bank. The location of the bottom stakes was obtained by measuring from this rod, by which means they were placed in alignment and to grade every 20 feet. A line was stretched at the bottom between the 20-foot grade stakes, and the bottom was then cut to grade. Strips of iron, 1 inch wide and one-fourth inch thick, were placed on the sides every 3 feet, extending up and down the slopes, the slope given them being the slope of the finished ditch. They were set in position by the use of a specially constructed device, which gives the correct slope, the grade line giving the proper position for the lower end of the iron rod. These iron strips were set every 3 feet along the slopes. A sharp iron straight edge, a little over 3 feet in length, was used to shave off the irregularities between them, or if below the alignment the depression was filled in and well tamped. Usually there were two gangs of men; the rough finishers came first and removed the larger irregularities, tamping the sides and bottom; then the smooth finishers brought the surface exactly true.

The cement men usually followed the finishers about a half day. If the earth had dried it was usually well sprinkled. Wooden strips  $1\frac{1}{4}$  inches in width, three-fourths inch thick, and equal in length to the width of the sloping sides were placed flatwise on the slopes. They were placed 3 feet apart, and served as guides to a straight edge, which assured a uniform thickness of three-fourths inch mortar.



The mortar was mixed on top of the bank in galvanized-iron portable mixing boxes and spread uniformly between the wooden strips on the slopes. With the straight edge as a guide all irregularities were removed and the mortar was finally compacted with the trowel. After the slopes had been lined the bottom lining was put on. A good lining three-fourths inch in thickness was thus obtained.

The plaster is composed of one part of good Portland cement to four parts of clean sharp sand.

The Jerupa Canal is also lined with cement plaster; the thickness of the lining, however, is only one-fourth to one-half inch. The earth ditch was not brought to grade as accurately nor the sides finished as smoothly as for the Gage Canal Company. The water channel was trimmed approximately with shovels; the sides and bottom were then sprinkled and the mortar spread with trowels to a uniform thickness as nearly as possible.

The instances where road oil has been used for canal or reservoir lining are few. The only example of its use for canal lining in California known to the writer of the report is at Lemoore, in Kings County, on the Madison branch of the Lemoore Canal and Irrigation Company. In this locality the canal is shallow; the velocity of the water is small, and the growth of weeds and aquatic plants in the canals is abundant. A large resistance is offered to the flow of water, which means a small carrying capacity, and a large loss due to seepage and evaporation. It is necessary for the irrigator to clean these frequently, sometimes as often as once every two weeks. The labor and cost are considerable.

Mr. McLaughlin, secretary of the Lemoore Irrigation Company, tried as an experiment the use of heavy road oil to prevent the growth of vegetation. The oil was applied in November, 1905, on a length of  $1\frac{1}{2}$  miles of the main canal. The canal is about 20 feet wide and about 1 foot in depth.

The oil used was crude petroleum from the Sunset district southwest of Bakersfield, and contains a large percentage of asphaltum. Its specific gravity is  $11\frac{1}{2}$  on the Baumé scale. This oil when cold will not run freely. It was used hot and sprinkled with an ordinary road sprinkler. The ditch had been previously cleaned of all vegetation and allowed to dry. The road sprinkler was driven first on the bottom of the ditch and then on the banks. The oil was applied at the rate of  $1\frac{1}{2}$  gallons per square yard. The oil was then thoroughly harrowed in until it was well mixed with the soil, which was very sandy.

When examined about seven months after the application of the oil there was no vegetation in this part of the canal, while other parts of this same canal which had received no oil and had been cleaned two weeks previously showed a vigorous growth of vegetation. The contrast is very striking and clearly shows the value of oil in preventing the growth of aquatic plants. Not only was this part of the canal

free from vegetation, but it was only about one-third full, while the canal full of weeds had to be full to carry the same amount of water.

The cost data given are summarized below:

*Description, nature, and cost, per square foot, of canal linings used in California.*

	Cents.
Rocks laid in hydraulic lime mortar, 8 inches thick, plastered with cement mortar, 1 to 3 mixture (labor, \$1.25 per day; lime, \$1 per barrel)-----	6.5
Cobbles laid in lime mortar, 1 foot thick, faced with cement one-half inch thick, 1 to 3 mixture-----	13.0
Cobbles laid in cement mortar, 6 inches thick (labor, \$1.75 per day; masons, \$3.50 per day; cement, \$3 per barrel)-----	13.0
Cement concrete, 4 inches thick, 1 part cement to 7 parts coarse gravel (labor, \$2 per day; foreman, \$3 per day; cement, \$2.85 per barrel; gravel, 60 cents per cubic yard)---	10.5
Same, 3 inches thick-----	8.0
Cement mortar, three-fourths inch thick, including preparation of banks (1 to 4 mixture)-----	4.0
Cement plaster, one-fourth to one-half inch thick-----	2.0
Cement plaster, 1 inch thick, 1 to 4 mixture on bottom and 1 to 6 on sides-----	2.88

It is the common belief that in climates where the ground freezes to a considerable depth in the winter plaster or concrete linings in earthen channels are not practicable, because the heaving of the ground will break the linings. But Doctor Mead reports the practice in Italy of covering the concrete lining with earth or sand to protect it from freezing.<sup>a</sup> The channel is cut larger than the required cross-section, lined, and the earth protection placed over the lining.

A lined canal can be given a much steeper grade than an unlined canal, because it is not necessary to guard against erosion, and where the fall is available the decrease in the size of channel required to carry a given quantity of water and the decrease in the quantity which must be diverted to supply a given quantity at the place of use will in many cases reduce the cost of excavation sufficiently to meet a large part of the cost of lining. If to this be added the decreased danger of breaks in canal banks, the doing away with injury to low lands by water seeping from canals, the stopping of the growth of aquatic vegetation in canals, and the stopping of the deposit of silt by the increased velocity of the water, it is believed that this lining of canals will prove profitable in many places where it has not hitherto been considered so. It may mean a slightly increased first cost, but a greatly decreased cost of maintenance. However, the great losses are from canals already built without linings, so that what has been said regarding decreased cost of excavation will not apply.

<sup>a</sup> U. S. Dept. Agr., Office of Expt. Stas. Bul. 144, p. 36.

With these existing ditches the problem is to check or stop the losses at a cost which can be borne by the crops grown under them, rather than rebuild the canals, although in some extreme cases rebuilding might be the most economical solution.

Almost all water, and especially that from streams, carries some silt, and this silt deposited in canals is the most effective check upon seepage losses which has been found, except cement lining. But in order that silt may be deposited the velocity of the water must be low. Many canals, especially the older ones, are built on such heavy grades that the silt is not deposited and the canals improve little with age. The remedy for this is the putting in of checks and drops, which will check the velocity and allow the settlement of the silt. But too low a velocity will cause the deposit of too much silt, encourage the growth of vegetation, which catches more silt, thus aggravating the trouble, and necessitating the cleaning of the canal.

When the water does not carry much silt the same effect has been secured by dumping pulverized clay into the water and keeping it stirred up in such a way that it will be carried down the canal and deposited along the bottom and sides. This has proved quite effective, but where the ground freezes hard in the winter the opening up of the soil by the frost is apt to destroy the effectiveness of the clay and make a new coating necessary.

Another experiment which has been tried with some success is driving sheep or hogs through the canal when it has some water in it, thus puddling the bottom.

Seepage losses from the Maxwell ditch in Umatilla County, Oreg., were checked by putting in the bottom of the ditch a mixture of manure, sand, and gravel. In the sections where the loss was greatest, the bottom of the channel was excavated to a depth of about a foot, and this space was filled with the mixture, which was thoroughly puddled with water. Upon this blanket the silt which had been removed from the channel was deposited, and also puddled under water by driving the teams back and forth over it. The beneficial effects were very noticeable, for where water had come through the banks in small streams they became dry.<sup>a</sup>

Measurements of the losses from the Irrigon Canal, in Umatilla County, Oreg., and an account of experiments made to stop these losses are reported by Mr. Stover.<sup>b</sup> Two series of measurements made in July and in August, 1905, showed losses from a section of the canal about 9 miles long averaging 8.8 per cent of the volume taken in at the head in each mile of ditch, when the canal carried at the head from 15 to 20 cubic feet of water per second.

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<sup>a</sup>A. P. Stover, *Irrigation Practice in Oregon*. U. S. Dept. Agr., Office of Expt. Stas. Cir. 67, p. 23.

<sup>b</sup>*Ibid.*, p. 26.

The season previous much work had been done on the canal channel in order to make it impervious. At that time it was thought that by plowing up the bottom of the channel and thoroughly incorporating with the sand such silt as had collected a more impervious layer would be secured, and to this end a great deal of work was done both in the way of plowing and harrowing the channel and also in the way of packing it by means of a corrugated roller. After this work had been done it seemed as though the channel lost as much water as it had before being treated, and at the beginning of the season of 1905 it was decided to abandon this practice and simply leave the silt to collect as quickly as possible and form a compact layer on top of the sand. The result was that wherever the velocity of the water slowed down a heavy deposit of silt occurred and considerable bodies of silt were formed in the channel. As soon as sufficient silt had collected to form a rooting place for aquatic plants a growth of moss sprang up, which also aided the deposit of silt. Silt bars formed wherever the water formed an eddy or wherever the velocity was decreased, and these bars at the time the first series of measurements was made had increased in size to such an extent that they formed a serious obstruction in the channel, backing the water up upon the banks and increasing by a considerable amount the wetted perimeter. This increase in the wetted section, of course, only tended to increase the amount of seepage, and although the canal channel appeared to be full of water, it failed to deliver any considerable amount into the distributing laterals at the end of the system. Soon after the first series of measurements was made a campaign was begun to rid the channel of these obstructions. It was thought best not to get rid of this silt entirely, but rather to stir it up and permit it to pass on down the channel and deposit more uniformly in other sections. The bars were harrowed down and the silt was kept thoroughly stirred up in the water and allowed to flow on down the canal. After the worst bars had been reduced a spring-tooth harrow and also a disk harrow were used to further assist in evenly distributing the silt. This treatment, however, seemed to stir up the bottom of the channel much in the same way as did the treatment it received in the previous year. At this time the second series of seepage measurements was made, and the results indicate that the loss was not greatly different from what it had been before the silt bars had been reduced. The wetted perimeter had been lessened, but the wetted surface had been stirred up and made more porous. With a view to producing the same beneficial result without this stirring factor it was suggested that a specially devised implement might be used. This implement consisted, essentially, of a long anchor chain, the ends of which were attached to a beam placed across the running gear of a wagon. This was drawn up and down the canal in such a manner that the loop formed

by the chain covered the entire wetted perimeter of the channel and not only stirred up the silt and prevented the moss growing, but had a rolling effect and thereby compressed the surface of the channel. This device was used continuously for about three weeks, with the result that water was delivered to the foot of the furthestmost lateral with a slightly decreased amount entering the headgate—a thing which would have been quite impossible at the time the first series was made. Measurements showed that by this treatment the loss was reduced to 3.6 per cent per mile. The chain was at first suggested as a possible means for preventing the excessive growth of moss, but after having been used for this purpose it was found that it not only prevented the growth of moss, but also served to puddle the channel. At various points along the line, where loss through the bank had been visible,

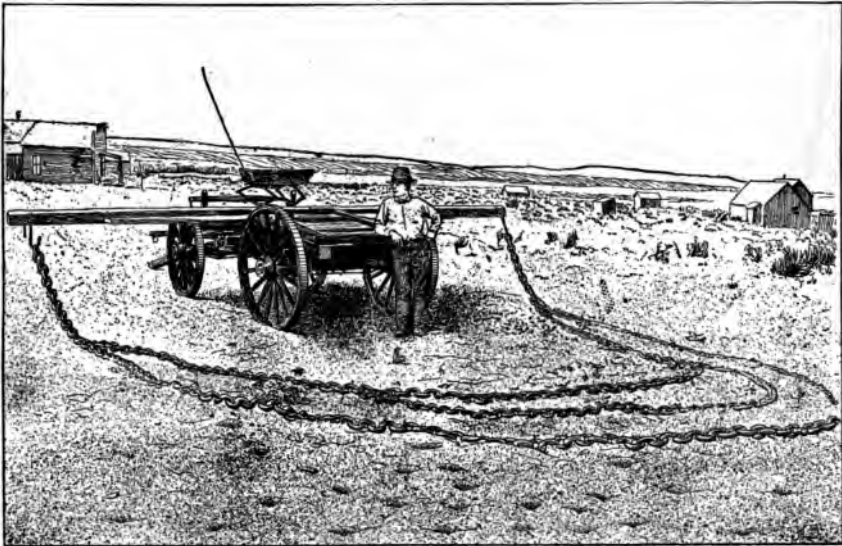


FIG. 30.—Chain puddler.

the leakage was stopped, and places below the canal which had been filled with standing water rapidly dried up, showing that the channel had been made quite impervious. This implement as first constructed was made of the hind running gears of a wagon, across which was placed a long beam and at the ends of the beam the ends of the heavy chain were fastened so that when the running gears were drawn forward the chain dragged in a long loop and had a rolling effect, which not only tore out the roots of the moss but also rolled and puddled the surface. Encouraged by the beneficial results obtained with this crude implement, a longer and heavier chain was secured and the implement shown in fig. 30 was constructed. This soon developed a weakness in one respect. The long loop of the chain

tended to roll the silt from the sides of the channel toward the center. The implement in its latest form has the chain fastened or hung from the supporting frame in a manner indicated by fig. 31, and the dragging of the earth toward the center of the channel has been almost entirely eliminated.

It often happens that the greater part of the losses from a canal occurs in comparatively short sections, which are located by the appearance of the canal or by measurements. In such cases it is common practice to build flumes to carry the water over these sections.

As stated in the beginning of this paper, seepage losses from canals can be stopped. It is merely a question of expense and value of the water saved.

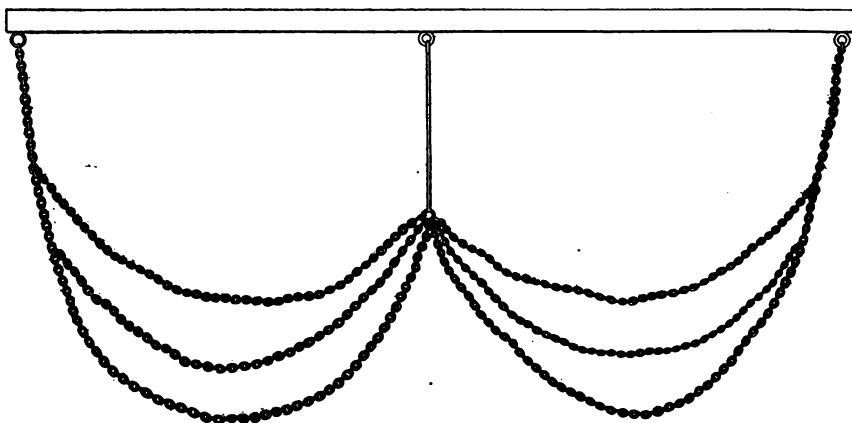


FIG. 31.—Modification of chain puddler.

### LOSSES IN THE APPLICATION OF WATER TO LAND.

Further large losses occur when water is applied to the soil. These losses are due to evaporation from the wet soil, percolation into the soil beyond the reach of plant roots, and careless use.

To determine the losses of water by evaporation from soil surfaces and the possibilities of checking them, experiments were made in California by this Office in cooperation with the State. Tanks containing soil were so arranged that they could be weighed, weighed quantities of water were applied to the soil in these tanks, and repeated weighings showed by the differences the quantities of water lost by evaporation. Comparisons of the tanks receiving different treatments showed the effectiveness of the different methods in preventing losses. Field conditions were imitated as nearly as possible.

The first experiment had for its object the determination of the losses by evaporation from the soil from the time water is applied

until the soil is fit to cultivate, and a comparison of the losses from cultivated and uncultivated soils. The tanks received sufficient water to cover them to a depth of about 12 inches. At the end of five days they had lost 15 per cent of this water. One set of tanks was then cultivated by stirring to a depth of 6 inches, while the others were left uncultivated, and after six days the weighings showed that the uncultivated tanks had lost an additional 11.3 per cent of the moisture originally applied, and the cultivated tanks had lost during the same time 5.7 per cent of the original amount, a difference of 5.6 per cent of the amount applied in favor of the cultivation, or about 50 per cent of the loss from the uncultivated tanks during the six days.

A repetition of this experiment with smaller quantities of water showed losses from all tanks of 10.5 per cent of the amount applied in the first three days after the water was applied, and during the next three days a loss of 3.6 per cent from the uncultivated tanks, and only 1.2 per cent from the cultivated tanks. That is, two-thirds of the loss during the second period of three days was saved by the cultivation.

Experiments to determine the effectiveness of mulches of different depths showed losses in fourteen days of 22.5 per cent, with no mulch; 7 per cent with a 4-inch mulch; 2.5 per cent with an 8-inch mulch, and 1.5 per cent with a 10-inch mulch, showing that the 10-inch mulch almost stops evaporation. This experiment did not imitate field conditions very closely, as the dry mulches were placed over the soil after the water had been applied, which could not be done in the field.

The next experiment imitated field conditions much more closely. In California a few years ago the common practice was to apply water to orchards in a large number of shallow furrows made between the rows. The present tendency is to decrease the number of furrows and increase their depth. This experiment was made to determine the advantages of the more recent practice. Water was applied to the surface and in furrows 3, 6, 9, and 12 inches deep. In a ten-day period the losses were, with water applied at the surface, 25 per cent of the quantity applied; with 3-inch furrows, 21 per cent; with 6-inch furrows, 17 per cent; with 9-inch furrows, 16 per cent; and with 12-inch furrows, 12 per cent. In other words, applying water in deep furrows prevented one-half the loss which occurred when water was applied on the surface.

These results apply, of course, almost solely to orchards, since with crops which cover the surface, or with annual crops with shallow root systems, the water must be applied on or near the surface. The experiments show that in round numbers about one-fourth of the water applied to orchard soils is lost by evaporation in the first ten or fifteen days after irrigation when water is applied in such a way that

actually enters into the growth of crops. The remaining two-thirds represents the field for expansion when the visible water supply is exhausted. Some of this loss is unavoidable, and some can be prevented only at a prohibitive expense, but a large part can be prevented without expense by careful use and an adaptation of methods of applying water to soil conditions.

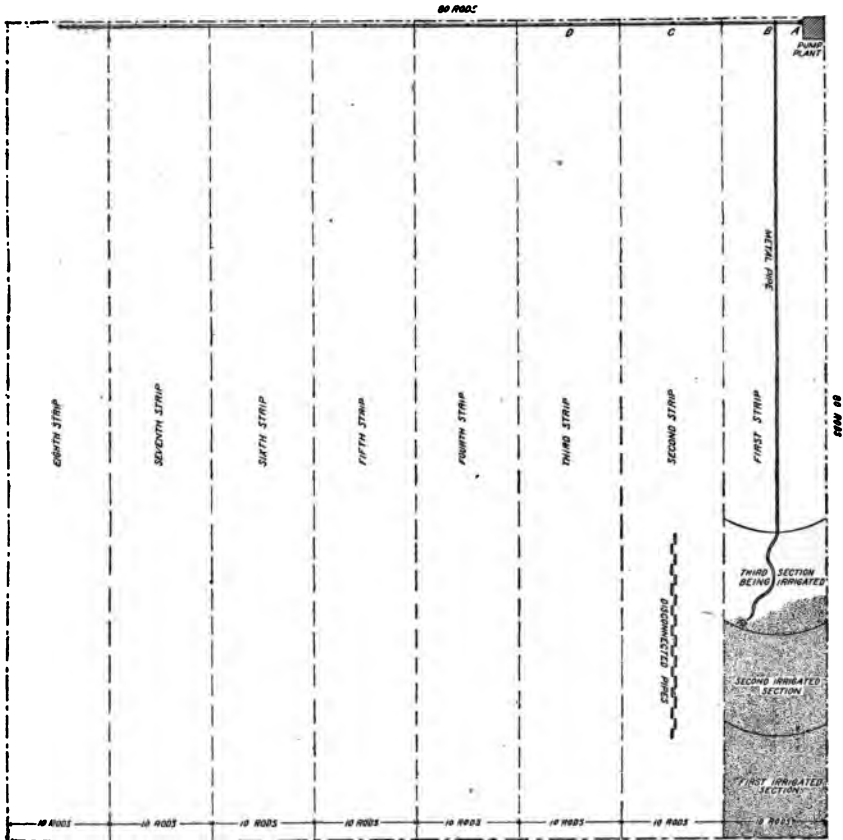


FIG. 32.—Irrigating field strips.

### INFLUENCE OF CONTRACTS AND REGULATIONS ON WASTE OF WATER.

What has been said is based upon the assumption that the water user is free to apply water in the way which he considers most economical. Very often in practice this is not true. He may be able to secure water only in times of flood, when he gets a large volume for a short time, or he may have the continuous use of a small stream, and he must use the water as it comes or provide storage, which may be too expensive. He may receive water from a canal company which



delivers water in large streams which are used in rotation, or from one which delivers water in small streams flowing constantly. It often happens that water-right contracts and canal regulations are drawn in advance of settlement, so that they do not fit the requirements of the lands irrigated. For some soils the small stream flowing for a long time is by far the best, while for other lands it is almost useless, and misfit systems of distribution are often responsible for serious waste when the farmer realizes fully that they are wrong.

It has been found that water-right contracts affect the quantity of water used in another way—that is, by the system of making charges for water. For years the most common form of contract was one in which the canal company agreed to supply a stream of a given size continuously for the irrigation of a certain number of acres—in Colorado 1.44 cubic feet per second for 80 acres—the use of the water being confined to a particular tract described in the contract, and the water user agreeing to turn off the water when it was not needed, and to use it on no other land. A further clause provided that when there was a shortage of water each water-right holder should have only his pro rata share of what there was. Such a contract affords no incentive to economy, since the water user can neither use the water saved on his own land nor sell it to another. If he shuts off the water, the company is likely to make this an excuse for selling rights to new land, in this way aggravating the effects of drought when there is a shortage. Therefore the farmer has a double reason to use all the water he can get—he gets no benefit from his saving, and he wishes to protect himself for the future.

Another common form of contract is that in which the charges are based upon the area irrigated, the company agreeing to furnish sufficient water for the lands described in the contract, with the usual prorating clause. Here, again, there is no inducement for the farmer to economize, as he wishes to make his necessities appear as great as possible in order that he may have the water in case of need.

A third form of contract provides for the delivery of a stream of a given size without limitation as to the place of use. The regulations of stock companies which provide that each share of stock entitles its holder to a certain portion of what water the canal supplies are similar in effect. In each case the farmer is at liberty to use his water on as much or as little land as he chooses, and he will tend to use his water carefully, making it bring him the largest possible return.

A few companies supply water on a strictly quantity basis, usually fixing a minimum quantity which must be paid for, but above this charging for the quantity taken. These contracts have proven most effective, since the direct reduction of charges produced by economical use is a very tangible evidence to the farmer of the benefits of economy. In other words, self-interest is a most powerful factor in bring-

ing about an economical use of water. In most systems of delivery, as has been pointed out, self-interest compels the farmer to use all the water he can get. To be sure, canal companies are inclined to contract to deliver more water than they can get and then prorate their supply, in this way forcing a certain degree of economy, but this very fact impels the farmer to use all he can get whether he needs it or not.

#### THE INFLUENCE OF LAWS UPON THE WASTE OF WATER.

The same principle holds with regard to laws fixing the nature of water rights. Almost every arid State has a law prohibiting the waste of water, but between absolute waste which can be detected and stopped by a public official and economical use there is a wide margin for saving which can be reached only by making it an object to canal owners to economize. The water-right laws of the States, looked at from this standpoint, fall in two classes—those which allow the acquirement of rights to fixed quantities of water and those which allow rights for specified tracts of land, with a maximum limit on the quantity of water which may be used. The whole experience of the arid region shows that the former system leads to the more economical use of water. The owner of a right of the first class may use the water on as large an area as he pleases, and in order to get the most out of his water will make it cover as large an area as possible, and if he can not use it himself he can dispose of it to some one who can, getting a direct money return for his saving. The owner of a right of the second class can use water on the designated tract only, and is entitled to enough for that tract within the statutory limit. Any saving remains in the stream for the use of some one else, without any advantage to the one who saved it, and creates a presumption that no more water is necessary for his land, which may shut him out from a larger use in the future if a change in his system of agriculture makes his demands greater. Consequently the constant tendency is for the holders of such rights to use the maximum allowance.

Statistical proof of the statements just made are not available on account of the difficulty of eliminating the effects of other factors. It is seldom that the two systems are in operation under the same canal or along the same stream, and differences of soil, crops, climate, habits of the people, general advancement of the industry, and the sufficiency of the water supply affect the quantity of water used. However, a few comparisons have been possible. Under the Northern Canal, in the Pecos Valley, New Mexico, water was delivered under both systems and those paying the acreage rate used 27 per cent more water than those paying the quantity rate. Under the Ridenbaugh Canal, in the Boise Valley in Idaho, the change was made from an acreage rate to a quantity rate, and while this change was in progress both

systems were in operation at the same time. Measurements made at that time showed that those paying the acreage rate used 40 per cent more water than those paying the quantity rate. While all other factors may not have been eliminated, it is fair to attribute the greater part of this difference to the difference in the bases of the charges.

Applying this principle to the lining of canals to prevent seepage losses, no company would willingly undertake such an enterprise if all the water saved went, not to its customers but to the source of supply, to be used by others, which would be the case if the company were limited to a described area and was entitled to sufficient water for that area. Further, it would be extremely difficult to induce an orchardist to double the amount of labor on his orchard to prevent evaporation, in order that some other orchardist should have a supply of water without contributing in any way to the expense of bringing about this saving. Recognizing this the attorney-general of Nebraska held that in that State, where the canal owner is entitled to sufficient water for a described area with a limit of 1 cubic foot per second for 70 acres, the measurement must be made at the head of the ditch, since allowing this quantity at the point of use would deprive the owners of later rights of the quantities lost from the ditch rather than the owners of the poorly constructed ditch.<sup>a</sup> In other words, it would be placing a premium on poor construction, at least, giving no incentive to good construction.

The first essential to the saving of the large losses pointed out above appears to be, then, a system of water laws and of rights under canals which will bring into play the self-interest of the holders of rights to water from either a public stream or a canal. Having the incentive, the water users will look for means of preventing losses, and then, as stated in the introduction, it becomes a question of cost and returns.

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<sup>a</sup> Report of Secretary State Board of Irrigation, 1901-2, p. 218.

## PROGRESS IN DRAINAGE.

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### INTRODUCTION.

An interesting and instructive bit of history attaches to the town of Maubeuge, in northern France, situated in the valley of the Sambre River. In the early part of the seventeenth century a certain convent garden of that city became known far and wide for its luscious fruits, rich vegetables, and velvet lawns. The visiting friars who partook of the hospitality of the monks lingered long in the shade of its fruit-laden trees, and when journeying homeward did not neglect to sound the praises of the convent and its garden. So superior and constant were its products that it became known as the "magic garden," and was regarded as the medium through which special divine favors were conferred upon the pious monks. Revolutionary tumult and wars finally destroyed the convent and scattered its devotees, and in 1793 the estate passed into the possession of the municipality and was converted into a park. The changes wrought upon the land incident to this work revealed the secret of the wonderful garden. At a depth of 4 feet there were found 4-inch drain pipes, hand made, like ancient pottery, traversing the garden in numerous lines which converged at a well into which they discharged their water. The magic garden had been underdrained, but at what time is not now known. Its peculiar fruitfulness had been the admiration of all visitors and the pride of the townspeople since 1620. It is this scrap of history which leads the French agriculturists to claim so tenaciously the honor of the discovery of underdrains and their application to agriculture. They reluctantly admit, however, that they failed to avail themselves of the fruitfulness of the invention, if such it can be called, and they grant to English farmers the credit of its rediscovery two hundred years later, when it became a subject of importance in both countries.

The marked difference between agriculture in a drained and undrained country is noted by travelers who enter Holland from the continental side. The late Colonel Waring, to whose facile pen we owe a most delightful description of Dutch agriculture, says:

We entered the Kingdom of the Netherlands by its back door, and realized immediately the presence of the transforming hand of the Dutch wizard of Drainage. In East Friesland the ditches had been full nearly to the brink,

vegetation showed the ill effect of a wet soil, and there was a general air of swamp and fog over the land and its people. Here the water was 3 or 4 feet below the surface, the land was dry, the growth was magnificent, and, though the country was as flat as the sea, there was no suspicion of wetness anywhere. The few people whom we met were hardy and red-cheeked. The farm houses and barns grew larger, and hay and grain ricks multiplied. Perhaps nowhere else in the world is such a sudden change of condition to be seen in a country of precisely the same original character.

While this description was written in 1873, we are assured by more recent visitors that drainage, supplemented by the unabated industry of the people of the low country, is still regarded as the basis of their prosperity.

The Fens of England, comprising 680,000 acres, are a notable example of what it is possible to accomplish by drainage. The millions of acres of Italian marshes reclaimed by drainage are another illustration of its power, in this instance not only converting waste land into fruitful fields, but staying the ravages of disease by removing its cause.

In our own country we point with grateful pride to the Johnston and Yeomans farms in western New York, where this method of bettering soil was first brought to the attention of American farmers. The year 1835 marks an epoch in the agriculture of this country which should be remembered, since it was then that John Johnston introduced drainage upon his farm bordering on Seneca Lake, and for twenty years following this date continued an ardent and forceful exponent of what was then considered among farmers a work of doubtful expediency. A paper describing his work in draining, to which was awarded the first prize by the New York Agricultural Society in 1851, compares the drained and undrained portion of a field as follows:

The usual care was given to the cultivation of the whole crop which, during its growth, showed a marked difference between the drained and undrained portions of the field. The product from the drained portion proved to be 83 bushels of corn per acre, the largest yield ever produced in the county. The field attracted much attention from my neighbors, who examined it at the time of draining and during its cultivation. The following season I cropped it with barley and found the drained land produced altogether the finest plant and the best yield of grain.

It may be said with reference to this farm that now, after the lapse of more than sixty years, its drains prove as satisfactory as when the above description was written, and the present yields of 40 bushels of wheat per acre attest its productiveness and bear witness to the value of drainage as a means of restoring a farm which three-quarters of a century ago was pronounced cold, wet, and worthless.

Mr. T. G. Yeomans, a nurseryman and orchardist of Wayne County, N. Y., had during the same time proven the value of drain-

age to orchards, and later he drained his entire estate of 400 acres, the fruitfulness of which is convincing evidence of the permanence and efficiency of the work which he performed fifty years ago.

These lands upon which thorough drainage was practiced in this country were not marsh or swamp, nor was their surface level. No more delightfully undulating country can be found than the Johnston farm in Seneca County. The surface slope of the fields is abundant, but the natural drainage thus afforded is insufficient, because the soil is retentive and rests upon firm clay. The soil of the Yeomans estate is a sandy loam of excellent appearance, but the subsoil is retentive and the crowns of the knolls when undrained are often as wet as the lower lands. Underdrains placed between the rows of the trees have for fifty years been effective in preserving their fruitfulness. This is no fancied effect nor one peculiar to conditions which prevailed a half century ago, for a recent report of an examination of the orchards of that county made by the State college of agriculture asserts that 30 per cent of the existing orchards require drainage in part and 8 per cent throughout.

This pioneer work was extended in time to other fields and to other States as required by good husbandry, until now widely scattered examples of profitable drainage are found throughout the United States.

Thus we see that the value of drainage has been known and its benefits enjoyed through centuries of time in widely separated countries and on lands greatly diverse in surface and soil. The magic garden, with its long-hidden secret; the thriving, prosperous Netherlands, once ocean swept; the fertile fields where a century ago lay the deadly marshes; the millions of acres of cultivated land in our own country formerly the home of the bulrush, cattail, or the cypress tree—all proclaim the power of drainage, its broad scope of usefulness, and the various methods by which it accomplishes its wonderful results.

### WATER OF THE SOIL.

The function of water in the soil is imperfectly understood by many successful farmers, but the most superficial observer learns that without it farm crops perish, with too much they fail, while with the proper amount they thrive and mature their fruit. For centuries the farmer believed that success in securing a living from the land was controlled by erratic climatic forces whose changes could not be predicted nor materially modified by his own efforts. He regarded sunshine, rain, and the fertility of his soil as gifts of nature, which promised a harvest if seeds were sown and the growing plants cultivated. Yet he looked forward to the outcome with dreamy uncertainty, counting himself doubly fortunate if his simple efforts were

rewarded by an abundant harvest. It remained for modern enterprise to eliminate some of the uncertainties of old-time agriculture. And where should the process begin if not with the soil, for is it not the farmer's capital, his storehouse of supplies, the source of his profits? Is not his inheritance which he should pass down to the succeeding generation enhanced rather than impaired in value?

Drainage is commonly thought of as the removal of water from the surface of the ground and as synonymous with drying the surface. This, however, is but the beginning of the process and is not of itself drainage in the sense of the term as it is used in good agriculture. With respect to this matter let us inquire into the relation which soil, water, and farm plants bear to each other. It is remarkable to what extent plants reflect the water and fertility conditions of the soil in their growth and fruitfulness. The soil must possess not only plant food, but also moisture and air, which are equally essential to the roots in the preparation of needed nutriment. The soil is made up of solid earth particles presenting every conceivable form and substance, of water commonly called moisture, which surrounds each particle, and of space between the particles which results from their irregular shape and varying size. This space portion is always occupied by either air or water, and its condition virtually controls the plant-producing ability of the soil. Primarily, drainage has to do with soil space by regulating the amount of water and incidentally of air, thereby producing the conditions most favorable for roots and of which they promptly avail themselves. When water covers the surface these conditions are impossible, but when it has been taken off by natural or artificial channels some lands possess the property of removing the excess of water from within the soil by natural percolation and evaporation, while others will remain wet until additional means of draining are provided.

A large volume of water is required to mature a crop, yet the amount should be so controlled that it will be supplied regularly as needed and without rendering soil conditions unfavorable to thrifty growth in other respects. It is stated by experimenters that 300 to 500 pounds of water are used in producing 1 pound of dry vegetable matter; that 30 pounds of water pass off through a single corn plant during its period of growth, and that on summer days 1.4 pounds of water are evaporated from a square foot of leaf surface. While this enormous demand of plants is supplied only by rainfall, which is taken out of the soil through the roots, and seems an almost incredible amount, it should be remembered that an inch in depth of water on a single acre weighs 101 tons and that the annual precipitation of 20 inches to 48 inches is exceedingly irregular in time and variable in quantity. It is the office of drainage to remove the excess due to

unusual precipitation from both surface and interior of the soil, place the latter in condition to conserve moisture during periods of drought, and make it possible for air to enter and perform the work so essential to the preparation of elements for the assimilation of plants. When this is done the many salutary effects so often observed and commented upon follow in natural order.

### **DRAINAGE OUTLETS.**

The farm whose surface is diversified by creeks and other natural water courses possesses the first requisite of good drainage, namely, an outlet into which all surplus water may be discharged, without the necessity of the owner first obtaining the consent of the adjoining property owners. Such a favorable condition is nature's gift, to which the landowner holds title by virtue of purchase or inheritance. He may adopt such improvements as suit his convenience or increase the productiveness of his farm. He is not free to do this, however, when his property is distant from such streams. There are large areas of level or slightly undulating plains in our humid sections which have no pronounced water channels, no stream near at hand adequate to receive the volume of water which at times must be disposed of before such lands can be profitably farmed. The table-lands at the heads of the streams in glaciated sections such as are particularly noticeable in Ohio, Indiana, Illinois, and Iowa, the plains left by lakes of past geological ages, like the valley of the Red River of the North, and the extensive river valleys and deltas which are nearly level, are lands having inadequate natural drainage, and, it may be added, embracing some of the most valuable food-producing portions of the world.

In the early attempts of farmers to develop the productiveness of lands by draining it was soon seen that artificial channels must be made where natural ones were either wanting or deficient in size. It was learned that a community of interest had been imposed upon landowners by natural conditions, a situation which required their cooperation in the prosecution of needed work. This gave rise to the enactment of State drainage laws which have been remarkably successful in bettering and reclaiming lands.

### **RELATION OF PUBLIC TO PRIVATE DRAINAGE.**

Land drainage operations should be considered in two parts. The first is the provision of the outlet channels which are required to receive the drainage from individual farms, and the second is the work which must be done upon each farm to give it complete drainage. The former is of a public nature in that it affects the interests of a considerable number of property owners; the latter is private and



pertains to work upon farms, gardens, and other land property. Laws are framed so as to permit the construction of drains which are of common benefit and are necessary as outlets for the drainage of individual properties. Landowners may in this way accomplish by artificial means what nature has in many places failed to do.

The relation of these divisions of the work is well represented by figure 33, which is a map of the drainage districts organized several years ago in Douglas County, Ill., under the State drainage law for the purpose of extending natural channels throughout the watersheds of the several streams and making of them efficient farm drainage outlets. What may be termed the arterial drainage of the entire county was perfected in this way. As performed in accordance with the provisions of the law, such work implies, however, that the drainage of the entire tract will in time be accomplished by individual effort, and for that reason the cost of public ditches should be charged against lands which will be benefited by them either in the near or distant future. The interrelation of natural, public, and private drainage operations is shown on the figure before referred to. At the time this work was inaugurated all farm lands in the county required draining. Lands bordering the lower portions of the streams were favored with natural watercourses into which drainage was discharged. These lands, of course, were drained first. Those landowners who did not have natural outlet channels were compelled to excavate large outlet ditches, which was done under the provisions of the law, before farm drainage could be accomplished. The plans for the more complete drainage district organizations now provide outlets for the land of every owner, thus obviating the necessity of later forming subdistricts for the benefit of farms which are distant from the main channel.

#### STATE GENERAL DRAINAGE LAWS.

Drainage laws are simple as to principles and are no more complex in their application and operation than other statutes. They have for their object the construction of drains for the common good through the cooperative efforts of landowners who will be benefited, and provide for the cost of the work by the collection of equitable assessments levied upon the property affected.

The following are the essential features of nearly all of the State general drainage laws:

- (1) The administration of the law is intrusted to the county board, to the county court, or to the circuit court.
- (2) The board or court is authorized to receive and act upon petitions for drainage filed by the required number of landowners.

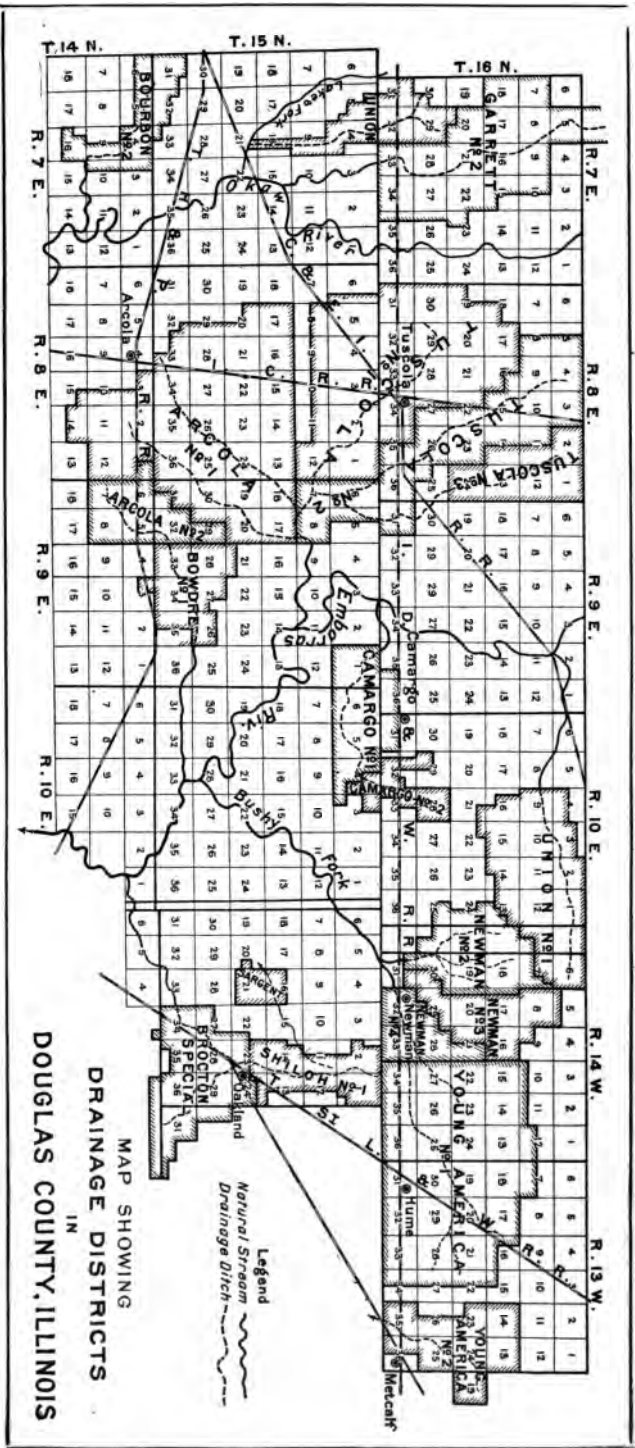


Fig. 33.—Map of drainage districts in Douglas County, Ill.

(3) The board, which under some laws is an elective one, must order an examination and survey of the project prayed for, after which it may grant or dismiss the petition.

(4) If granted, the board shall cause plans and estimates of the work to be made, and shall levy assessments for its cost.

(5) Objections of landowners may be heard and considered by the board, and an opportunity of appealing from the decision of the board to the court is provided for.

(6) The board is given direction of construction work.

(7) Payment for the work may be made either from the sale of drainage bonds, if such bonds are ordered by vote of taxpayers, or from a special drainage tax.

(8) The right of outlet is perpetual, and follows the title of the land.

The underlying principles of the laws are:

(a) The initiation of cooperative drainage is optional with the landowners; (b) the work must be conducive to the public welfare and be a work of general benefit; (c) the cost must be assessed against property in proportion to the benefit it will receive, though a few laws require assessments to be made according to actual value of the property; (d) property can not be taken for the common good without remunerating the owner; (e) property owners are given opportunity for presenting their grievances before the proper tribunal, and of obtaining an equitable adjustment of the cost of the work and also security in the use of the drainage privileges for which they are assessed.

The several steps in the procedure and their order are represented in figure 34, which is a diagram of the Iowa State law relating to the formation of drainage districts. Authority to drain lands is conferred upon each county board of supervisors, provided the board is petitioned to do so by landowners who desire drainage, but do not have outlets upon their own property.

### DIFFICULTIES MET IN CARRYING OUT THE LAWS.

The effectiveness of the law depends upon the attitude of the people who are directly concerned in the proposed drainage. Projects covering lands owned by one hundred or more different persons are not infrequently worked out, indicating that a fair degree of unanimity of owners ought to exist before the attempt is made to effect an organization. Some of the laws stipulate that a protest signed by the owners of two-thirds of the land included in the district shall be sufficient cause for the dismissal of proceedings.

In any movement toward drainage in which individuals obligate themselves to share the cost, the objections are often numerous, and

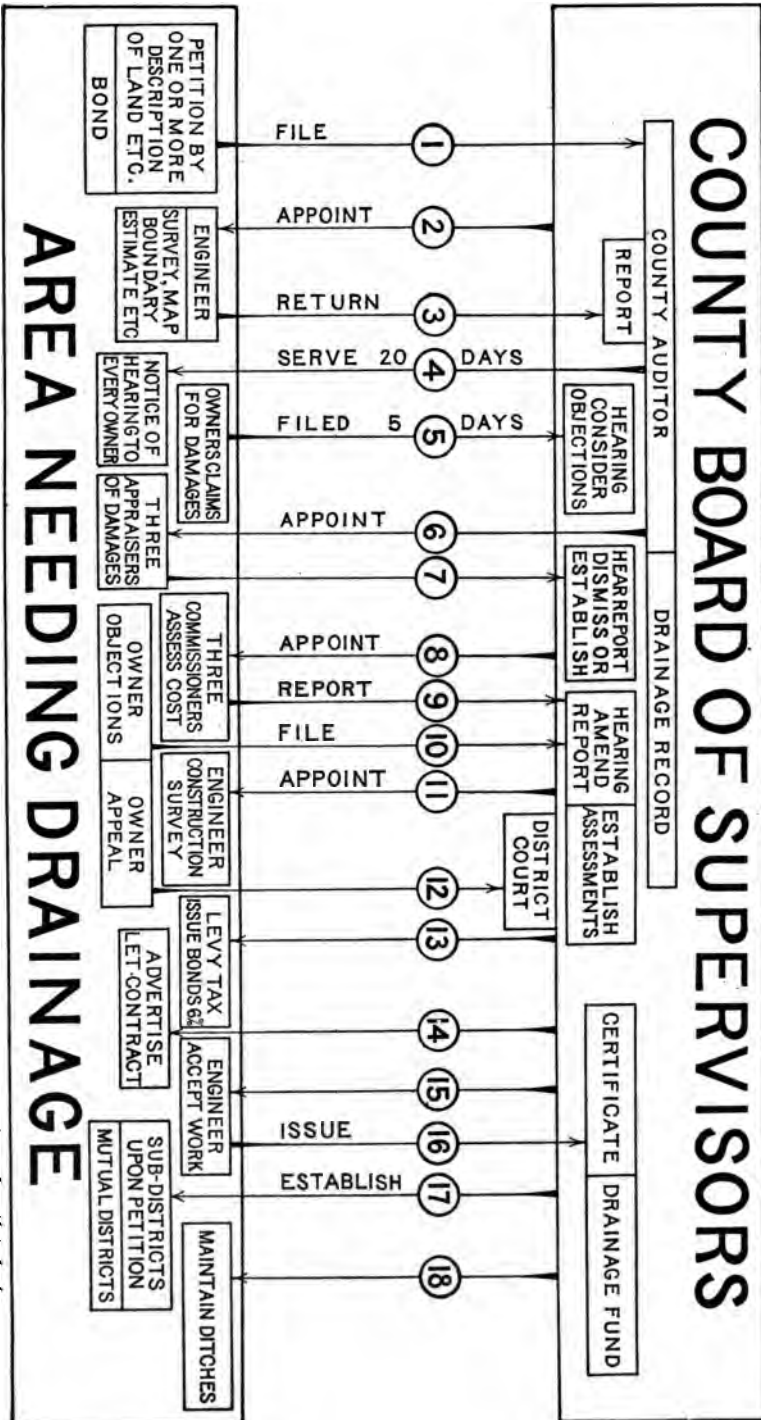


FIG. 34.—Diagram of Iowa general drainage law, showing successive steps required to secure construction of outlet drains.

though sometimes trivial, many of them deserve consideration. One property owner objects to his assessment as finally determined by the board because it is higher than his neighbor's; another avers that his land requires no drainage, and still another that the plan proposed is not the right one to follow. One, by persistent opposition to every move which is made to perfect the plans and inaugurate the work, secures an abatement of his assessment as the price of ceasing active resistance. Unexpected phases of human nature sometimes develop with astonishing rapidity under the practical operation of drainage laws, suggesting the old English chronicle: "He who would do any good in drainage must do it against the will of such as have profit in it."

This state of affairs has frequently led to unwise and costly litigation, or to superficial and inadequate drainage construction, requiring later, when serious errors began to show results, a partial or entire revision of the work.

### RESULTS THE INCENTIVE TO DRAINING.

The real value of draining must first be demonstrated in the field, the garden, or the orchard. No theoretical conditions and processes, but actual results convince farmers of the wisdom and profit of draining and encourage them to improve the old farms and to open up new ones in our swamp-land domain.

A few examples like the following, of the actual cost of draining land and of the results obtained, show the commercial basis upon which the improvement rests.

Example No. 1, from Wisconsin:

A 9-acre tract of marsh land producing willows, rushes, and marsh grass, and used only for grazing, was valued at \$40 an acre. It was thoroughly underdrained at a total expense of \$176.66, or \$19.62 an acre, making the entire cost of the land \$59.62 per acre. Its producing and market value at once became \$100 per acre, giving a rise of \$40.38 an acre, directly attributable to draining.

Example No. 2, Indiana marsh land:

COST.	
320 acres, bought in 1900, at \$25 per acre.....	\$8,000.00
Buildings .....	3,000.00
Fences .....	330.00
Draining .....	1,382.00
Management, five years.....	325.00
Taxes, five years.....	500.00
Total cost up to 1905.....	13,537.00

RETURNS.

Marsh hay 1900, 1901, 1902, land not drained.....	1, 200. 00
Rentals 1903, 1904, 1905.....	5, 065. 48
Total returns 1900 to 1905.....	6, 265. 48
Annual return 9.2 per cent. Land sold in 1905 for \$32,000.	

Example No. 3, from Iowa:

Eighty acres of marsh land, valued at \$20 an acre, producing only marsh hay, which netted the owner an annual rental of \$2 an acre, was drained at a cost of \$.650 an acre. It was then prepared for cultivation and rented for two-fifths of the grain which should be grown upon it. The first year the owner received a rental of \$6.25



FIG. 35.—Ditching with teams and scrapers. (Polk County, Minn.)

an acre and the second \$7.50 an acre. Such results obtained from draining attract the attention of landowners and encourage them to extend their efforts to other and larger fields which may be developed in a similar manner.

METHODS.

Next to the results the methods of draining are of most interest to the holder of wet lands. How to do the work economically and effectively concerns him more than the theory of the action of drains. It may be said here to the credit of American energy that greater advancement has been made in methods and in mechanical appliances for draining in this country than in any other. What may be re-



garded as the second epoch in the history of this work was the adaptation of the steam shovel to the excavation of large drainage ditches.



FIG. 36.—Floating dredge used in excavating drainage ditches. (Upper Kankakee River, Indiana.)

This was done in Illinois in 1885, fifty years after the introduction of underdrainage in western New York by John Johnston, and



FIG. 37.—Drainage ditch, 40 feet wide, excavated by land dredge. (Laporte County, Ind.)

marked most emphatically the beginning of the larger development of lands, the possibilities of which can scarcely be anticipated. Up

to that time all ditches had been opened by hand labor assisted by teams with plows and scrapers (fig. 35). It had not been possible to drain marshes and bogs of any considerable magnitude at a cost within the limits of agricultural profit. The steam land dredge, which when first tested failed completely, has been so perfected that ditches may now be made varying in width from 10 to 50 feet and as deep as 15 feet through otherwise inaccessible swamps. It is now possible to open water courses where none existed, and to enlarge and otherwise improve faulty channels, and to build embankments and levees for the protection of lands from overflow. Seven types of steam dredges and excavators are now successfully used in the larger classes of



FIG. 38.—Drainage ditch made with steam excavation machine. (Central Iowa.)

drainage work, and what was formerly impossible is accomplished at a cost less than that for work of the most simple and superficial kind prior to the advent of these machines. (Figs. 36, 37, and 38.)

#### **MORE PERFECT DRAINAGE DEMANDED.**

Of necessity agricultural practices change as population becomes more dense and internal improvements increase in number and permanence. The incentives to develop wet lands twenty years ago were fewer and less attractive than now. More convenient and stable markets and a demand for a greater variety of and more perfect prod-



ucts have created new economic conditions in American agriculture. Drainage has correspondingly developed to meet the demands for improved quality and increased quantity of production. The drains which were constructed during one decade have been enlarged, deepened, and perfected in the next. Drainage which satisfied the farmer three years ago fails to meet his requirements to-day, so rapidly have the advantages of more thorough soil preparation been thrust upon him by his own experience and by the practice of our foremost cultivators, with which he keeps himself acquainted. More perfect drainage has naturally followed pioneer and superficial practice, just as the pretentious farmhouse and convenient barns have supplanted



FIG. 39.—Drain tile laid in trench  $3\frac{1}{2}$  feet deep and ready for covering. (State Farm, Crookston, Minn.)

the uncouth cabin and straw-covered stable, or as the more perfect forms of the Hereford or Jersey have come to grace the fields where once only inferior and nondescript animals were seen.

The cost of drainage on the farm where small ditches and underdrains are required is greater now than in former years. Many machines for excavating trenches for underdrains have been made, tested, and discarded during the last fifty years because they failed to meet the varied conditions which were encountered. One or perhaps two machines are in a measure successful and with certain limitations will assist in trenching land for tile drains. Despite the introduction of mechanical aids the cost of farm drainage has nearly doubled

during the last fifteen years, attributable in the main to the advance in the price of labor and possibly in some measure to the lower standard of efficiency of laborers who are available for that kind of work.

The confidence which northern farmers have in covered drains as distinguished from open channels is also one cause of this increase in cost. (Figs. 39 and 40.) It is not uncommon for drainage districts or individual farmers in Illinois, Indiana, and Iowa to use pipes 18 and 24 inches in diameter, and even as large as 30 inches, in place of the smaller class of open ditches. The value of good land, the greater convenience of such drains over that of the open ditch, together with the pride which the modern farmer has in the appearance of his land,



FIG. 40.—Drain constructed with drain tile 24 inches in diameter. (Iroquois County, Ill.)

are sufficient inducements to lead him to pay the added cost, which not infrequently amounts to five times that of the open channel which would serve the same purpose.

#### MISTAKES.

It would have been indeed surprising if the progress of an art developed as this has been without established precedents which might be closely followed, and demanding so great an exercise of judgment and discretion as it does, has not been retarded by the commission of many more or less serious errors. These are of frequent recurrence, former experiences of others either being unknown or unheeded, and are often so grave as to necessitate the entire recon-

struction of drains. It may be well to call attention to some of the more common ones.

Main water courses are made too small and especially lack sufficient depth. The size of ditches is sometimes so poorly adjusted as to flood one portion of land in the attempt to drain another. Underdrains are too small in some instances and too large in others, the latter fault, however, entailing no injury to the land. They are often too shallow and are carelessly laid. A neglect to adapt systems and depth of drains to soil and climate accounts in some instances for the failure to obtain satisfactory results. Levees are weak, and their failure discourages the holders of overflowed lands for a time from further attempts to reclaim them.

These and similar errors are the result of a lack of thorough understanding of the principles which govern drainage practice or of knowledge of the nature of soil and subsoil, or failure to estimate correctly the requirements of the situation. While unfortunate, they are all to be expected in the natural order of land development. Farmers learn to do by doing. No industry pays a higher price for its progress than agriculture.

#### **THE FIELD AND THE CHARACTER OF THE WORK BEFORE US.**

We have not passed through the various experiences incident to the development of wet lands, in the course of which educating the people, enacting necessary laws, planning and executing the works, making blunders and mistakes appear to have been essential features, without becoming better prepared to undertake the larger work of draining the millions of acres of wet land which now invite the efforts of the engineer and the enterprising agriculturist.

We find scattered throughout the country vast areas of wet lands in various stages of usefulness. There are southern forest lands, some of which are denuded of their timber and only await draining, clearing, and cultivating to produce staple crops in abundance. Others are covered with merchantable timber that will disappear in a few years, leaving the land open to agriculture. Many of these are extensive, low, and level without convenient drainage outlets and present some of the larger drainage problems which now confront us. They form units of 25,000 to 100,000 acres which must be treated as a whole. Their complete drainage can not be accomplished unless the owners unite in constructing ditches, enlarging and straightening natural channels, making levees, and other drainage works, so that farmers may improve their individual holdings in accordance with the teachings of good agriculture and prudent business management.

Where drainage laws are in force the owners of such lands must petition the proper authorities for the construction of drains that will

be for the common good, and must undertake the work with the intention of bearing each his just proportion of the cost. Legal difficulties must be adjusted and contracts let for construction, which preliminary work will require not less than a year. The construction of main drains for a district of 50,000 acres will require not less than two years' time. The steam ditching dredges must plow their way through the watery plain under adverse environments, which are little appreciated by those who view the land after it has been converted into productive farms. All this must be done before the individual can derive any direct benefit or proceed with the improvement of his property.

Though always profitable where the lands treated are fertile, the ease and cheapness with which swamp land worth \$5 an acre may be transformed into farms worth \$100 an acre are frequently misrepresented. The arterial ditches for a large stretch of country are absolutely essential, but are only the beginning of the reclamation. These may be constructed at a cost of from \$1 to \$6 an acre for the land which they serve. But other drains must be made, the land cleared and subdued, and working improvements placed upon it before it becomes worth \$100 an acre.

The extent of the domain which may be drained is no less astonishing than the diversity and abundance of the production which will follow its complete reclamation. It should be remembered that the need of drainage is not limited to swamp and wholly unproductive lands. There are fields scattered over the highly developed sections of our agricultural States which should be drained. Of the 85,000,000 acres of land which may be drained, one-quarter is already occupied as farms, the production of which may be increased 20 per cent by judicious draining.

A few examples will show at a glance the panorama of possibilities of such developments as well as the diverse problems with which we must acquaint ourselves. On James Island, South Carolina, the home of the sea-island cotton, Mr. G. W. Hinson has in operation a system of underdrains which discharge into the sea through automatic valve gates. The drains remove not only water which reaches them through percolation, but surface water through inlets which connect with the drains. These drains have cost him \$30 an acre, but as a result he enjoys immunity from malaria which prevailed before the land was drained, and his crops of cotton, sweet potatoes, peas, and asparagus net him annually more than the first cost of draining. Thousands of other farms in the South may be drained at a much less expense with equally gratifying results; many of them, however, are so linked together by natural drainage ties that outlets of a general and public character must be made before the plantation and truck farm can be developed.

Grand Island, in the Sacramento River, California, has been reclaimed after most discouraging failures. It comprises an area of 16,000 acres, which are protected by thirty miles of levees, and is provided with interior drainage ditches and two drainage pumping plants. The reclamation has been accomplished at a cost of not less than \$1,100,000. The surface is saucer-shaped; the outer rim, growing fruit, is valued at \$1,000 an acre; the interior low part, producing potatoes, beans, and asparagus, is valued at \$60 an acre, and yields an annual rental of \$11 an acre. This great work, extending over a period of thirty years, was finally effected by the thirty-five owners under the provisions of the State law. Other lands of equal value, which can be drained with much less difficulty, are found on the Pacific slope, but, as in this case, the aid of the State law must usually be invoked.

The great corn belt of Illinois is covered by drainage district organizations which have joined the swamp areas with the natural streams by means of large ditches. The vast areas of river bottom and delta lands, as well as the table-lands of the Northwest, may be drained in the same general manner.

Nor is this all. We have the swales and bogs which follow in the wake of the modern reclamation of arid lands. Not less than 200,000 acres of land in the State of Utah are injured by surplus water and require draining, while other irrigated States present in the aggregate a formidable drainage problem.

We may well apply ourselves to this work of draining the wet lands of our country, for a more important field in agricultural development is not found. Profit as we may by past experience, new lessons must be learned, and advanced farming practice must be met by better drainage methods. All of this must be accomplished by steps and not by great bounds. Agriculturists are wisely conservative. Farms are not built in a few months like factories and temples, but their growth from the land in its primitive condition to the pretentious rural estate is slow and must be developed in accordance with nature's laws.

As agencies to assist us in making this domain what it is possible to make it, we have our drainage laws, our steam excavating machines, our drain-tile factories, our steam trenching machines, our cement-tile plants, and above all the awakened interest and appreciation of an agricultural people. These should be used intelligently and wisely. The methods of draining should be intensely practical as well as scientific, and should be better understood by farmer and landowner. Experience teaches that business methods of conducting public and private drainage operations should be more careful and exact. We are driven to the conclusion that the progress of agricultural drainage so far in this country but feebly indicates the important place it is yet destined to occupy in perfecting the agriculture and developing its productive resources of our lands.

## AGRICULTURE IN GUAM.

In making the estimates for the appropriations for the Office of Experiment Stations for the fiscal year 1909 the Secretary of Agriculture has asked Congress to appropriate the sum of \$5,000 for the establishment and maintenance of an agricultural experiment station in Guam. The desirability of this action has been felt ever since the American occupation of that island, and nearly every governor has urged this Department to cooperate with the Navy Department in some such enterprise. Capt. G. L. Dyer, while governor of Guam, took an active interest in improving the condition of the natives, and his successor, Capt. T. M. Potts, has continued efforts along that line. In the autumn of 1907 the Secretary of the Navy formally requested the Secretary of Agriculture to cooperate in attempting to improve the agricultural conditions of the island.

Guam is situated in the Pacific ocean about 1,500 miles east of Manila and 3,300 miles west of Honolulu. Its area is about 300 square miles. In 1901 it had a population of approximately 10,000 people. The island is volcanic in origin and portions of it are rather rough, but it has been estimated that fully 65 per cent of the area is adapted to agricultural development. The people are practically all agriculturists, and the principal export of the island is copra. This is the dried flesh of the cocoanut, and has been a source of considerable revenue. A diseased condition of the cocoanut palm has lately been reported, and efforts should be made to control the trouble or the principal resource of the island will be lost.

The agricultural conditions and practices are decidedly primitive and are in urgent need of improvement. In 1905 an agricultural experiment station was organized under the local government for the purpose of investigating the agricultural problems of the island and to aid as far as possible in their amelioration. Thus far the work has consisted largely in experiments with various agricultural and horticultural crops and in the introduction and distribution of seeds and plants. One of the great drawbacks to agricultural progress in Guam is the destructive hurricanes that frequent that portion of the Pacific ocean. In times past there has been actual suffering due to the destruction of the main crops, such as cocoanut, bananas, and various other tropical fruits which require a long time for their development. With the introduction of other crops, some of which would require

short seasons for their production, the repetition of former experiences could be avoided to a considerable degree.

The one serious drawback to the work of the experiment station has been its lack of funds to secure proper equipment for carrying on investigations. It is wholly supported by a small sum set aside from the local revenues, and this amount just about supports the agriculturist, but does not permit of any extension in the work. There is an urgent need of modern equipment of plows, cultivators, and other farm implements, and this will be one of the first matters attended to.

Through the courtesy of the former governors, Capts. G. L. Dyer and T. M. Potts, and the present governor, Capt. E. J. Dorn, this Office has been supplied with a statement by Mr. H. L. V. Costenoble concerning the operations at the Guam Experiment Station during the past fiscal year, and an abridged account of them is given herewith.

**REPORT OF THE SUPERINTENDENT OF THE AGRICULTURAL EXPERIMENT STATION FOR THE PERIOD JULY 1, 1906, TO JUNE 30, 1907.**

DEPARTMENT OF AGRICULTURE,

*Guam, July 1, 1907.*

SIR: I have the honor to tender herewith my report of the department of agriculture for the period ending June 30, 1907.

**STATE OF AGRICULTURE IN GUAM.**

The state of agriculture has not changed much since my previous report. In fact, but very little change can be noted since the arrival of the Americans in Guam. The cultivation of rice seems to be gradually decreasing. The soil of the rice fields, which has been cultivated for many years without the application of fertilizers, has become exhausted, and consequently yields but small crops. The people are beginning to depend on imported rice from Japan and from the United States, although there are sufficient suitable lands for rice growing to make such importations unnecessary. Corn is grown in considerable quantity, as are also sweet potatoes, yams, and taro. Other vegetables are scarce. Beans, onions, mustard, peppers, and eggplants are sometimes grown in the little house gardens or in boxes, but not enough produced for the needs of the planters.

The planting of cocoanuts seems to be extending in recent years, but the carelessness of cattle owners causes much damage to the plantations. Young cocoanut palms seem to be much preferred to any other food by cattle, and they have destroyed whole plantations. Of a planting of more than 100 young palms two years ago, only three or four are left, the others having been eaten by cattle. Unfortunately a more serious danger to the cocoanut industry has appeared

through the importation of a cocoanut scale insect. As the damage done by this insect has been observed for only about three years, its introduction to Guam probably took place some five or six years ago. It is to be regretted that a report of this pest was not made earlier, as it would have been much easier to check the progress of the insect at the beginning than now, when perhaps two-thirds of the palm trees are more or less infested.

During the past season the weather has been very favorable to the growing of crops. The rainfall during the wet season was moderate and during the dry season there were sufficient rainy days to keep the crops in good growing condition.

#### AGRICULTURAL EXPERIMENT STATION.

The trial grounds around the station buildings have been enlarged by the clearing of a part of the hills to the southward. Since January 1 work was carried on in draining the large swamp to the eastward of Agaña by conducting a system of canals and preparing the land for cultivation. The owners of the ranches situated in this swamp have not only given permission to dig these canals through their lands, but have cooperated with the government by constructing auxiliary canals at their own expense under the supervision of the superintendent of the department of agriculture. It is believed that it will be possible to reclaim the whole swamp in this way, and by conducting the water of the Agaña River through canals to improve the sanitary condition of the town. Since April 1, through the labor of the prisoners of the Agaña jail, the work on the drainage of the swamp has made good progress.

Correspondence has been maintained with a considerable number of botanical and agricultural institutions and seeds of many valuable plants have been exchanged with them. Next to the United States Department of Agriculture, the station is most indebted to the department of agriculture at Buitenzorg, Java, from which seeds of valuable fruit trees of the Tropics have been received nearly every month. Specimens of interesting native plants and seeds have been collected by the United States Department of Agriculture, the department of agriculture at Buitenzorg, the botanical garden at New York, and the bureau of agriculture at Manila. A bulletin has been prepared and issued giving directions for the growing of vegetables in Guam.

Much inconvenience was caused to the station by the earthquake disaster at San Francisco, Cal. Since the occurrence of that calamity the station has been unable to get its regular monthly shipments of seeds, while those that were received came too late in the season to be planted.



**DISTRIBUTION OF SEEDS.**

Of all the schemes for agricultural improvement the free distribution of good seeds seems to many to be the best, easiest, and cheapest way of obtaining progress. The one great obstacle to this distribution in Guam is the indolence of the people. During the first year seeds were distributed by the station to a considerable extent. The common practice has been that these seeds were sown in weedy land where they had no chance of success, or they were kept for months unsown, and most of the imported seeds lose their vitality in this climate in about two weeks. During the second year another method was tried. When requests were made for seeds, half-grown plants from seed beds were offered. They were willingly accepted, and it soon became known that every Saturday plants were to be obtained free of cost at the experiment station. With every donation advice was given on how to plant and care for the crop. Apparently attention was given to the explanations, but none of the distributed plants were ever seen in the house gardens or on the ranches. It was finally learned that none of them had been set out, but they had been eaten immediately. After this discouraging experience seeds received this year from the Agricultural Department at Washington were offered for sale at the low price of 5 coppers ( $1\frac{1}{2}$  cents United States currency) for each package, with the result that a small quantity of seeds was sold. Where the seeds were purchased there was less likelihood of their being thrown away or neglected than where they were obtained free of cost. To school-teachers and Government officials seeds and plants in such quantity as desired were distributed free of cost.

**• EXPERIMENTS WITH GARDEN CROPS.**

The climate of Guam has variations resembling those of the Temperate Zone, the dry season corresponding to the summer, the beginning of the rainy season to autumn, the wet season to winter, and the end of the wet season to spring. Vegetables from temperate climates, as a rule, grow best in Guam during the seasons of their most successful growth at home. Many of those which do not grow during the winter in temperate zones almost entirely fail during the wet season here. There are a few exceptions to this rule. Cucumbers, for instance, grow best during the summer in the United States, but they are most successfully produced during the rainy season in Guam. An explanation of this may lie in the fact that while cucumbers thrive during the dry season they are attacked by a fungus, which occurs on the leaves and finally kills the plants, but apparently during the wet season the fungus is washed from the leaves by the heavy rains and the cucumber plants suffer less injury and, as a consequence, produce better fruit.

Thus far it has not been possible to find a variety of American onions adapted to the climate of Guam, and experiments were conducted to improve the native variety of this vegetable through selection of the bulbs. The so-called native onion is the shallot (*Allium ascalonicum*), which was probably introduced from Manila many years ago. Experiments were begun with it in May, 1906, and during the period from May, 1906, to April, 1907, three crops were harvested. The last crop showed 87 per cent of plants with four or more bulbs grown from selected seed, as compared to 68 per cent of plants bearing four or more bulbs where the seed was not selected. This experiment will be continued.

As a result of investigations in growing garden crops, a bulletin of vegetable growing has been prepared, as noted above. It contains practically all the information necessary for the people of Guam and includes also some of the elementary principles of scientific agriculture. These data are based on experiments conducted on a large scale, and it is now possible to give information as to the kinds of vegetables to be grown successfully in Guam and the seasons best suited for each kind.

#### EXPERIMENTS WITH FIELD CROPS.

The most important field crop of the island is corn, and it is planted by nearly every farmer. During the preceding year thirty experiments were carried on by the experiment station with seed corn introduced from the United States, Mexico, Peru, and Japan. Having failed to succeed with these, a series of experiments was begun to improve the native white variety of corn. Ordinarily this variety produced ears of fair size, but with a single ear to the stalk. It is seldom that a stalk is found bearing two or more ears. With ears gathered from stalks which produced more than single ears, experiments were carried on by selection, the type of ear adopted being a cylindrical one bearing ten rows of grains. These experiments have been continued, and in February, 1907, forty-one fairly typical ears had been secured from stalks bearing two or three ears each. These were planted in April, 1907; and are now in good condition.

In experiments in the trial fields on the hill next the experimental garden the possibility of harvesting other crops than sweet potatoes on the hills and elevated plains of the island during the dry season has been demonstrated. Two kinds of plants at least are to be recommended for such places. They are the beggar weed (*Desmodium tortuosum*), a valuable forage crop for cattle and horses, and the non-saccharine sorghums or Kafir corn. All of the varieties of the latter planted, namely, durra, Jerusalem corn, and broom corn, did well during the dry season, and will furnish green fodder all the year.

Experiments in the production of forage will be continued next year, and planting velvet beans after the Kafir corn has been removed will be tested.

#### EXPERIMENTS WITH FRUIT AND OTHER TREES.

Fruits are scarce in Guam, and the introduction of fruit-bearing plants has been given especial attention. During the past year the following new trees were raised from seeds and the plants are in good condition: The baobab tree (*Adansonia digitata*), jack fruit (*Artocarpus integrifolia*), papayas (*Carica papaya* and *C. sp.*), species of citrus trees, *Flacourtia sapita*, *Lansium domesticum*, litchi and longan (*Nephelium lappaceum* and *N. longanum*), *Passiflora quadrangularis*, a species of guava (*Psidium aromaticum*), and the Japanese wineberry (*Rubus phœnicolasius*).

Experiments are being carried on to improve the papaya, a variety of which was introduced three years ago from Honolulu. While the introduced fruit weighs about 3 pounds and the native papaya of Guam only about half a pound or more, hybrids between these varieties have produced fruits weighing nearly 5 pounds. These hybrid papayas are not only larger, but they are sweeter and more juicy than either of the parents.

#### EXPERIMENTS WITH MISCELLANEOUS PLANTS.

The experiments with vegetables, which have occupied a great portion of the time of the superintendent, have given such satisfactory results that they will be continued only on a lessened scale, and more time devoted to such plants as will give products for exportation. Copra is at present the only export. New products are very desirable, particularly as they tend to lessen the risk of suffering due to the failure of a crop where only one staple is produced. The following plants have been introduced and are under observation: Mulberry, ailanthus, sponge gourd, Ceara rubber, elengi, nux vomica, tea, teak wood, Canary Island pine, and Korean pine. The mulberry and ailanthus have been introduced to provide leaves for silkworms, it being the expectation to develop this industry. The Ceara rubber tree appears to grow very well, and experiments with it will be continued on a somewhat larger scale than formerly, so that seeds and cuttings may be distributed if the results of tapping experiments prove successful. All the tea plants died of a fungus disease, and it seems probable that tea can not be produced in Guam. The teak and pines introduced are for the purpose of producing valuable woods.

**EXPERIMENTS IN RECLAIMING THE SWAMP OF AGAÑA.**

Mr. W. E. Safford, in his book on the Useful Plants of Guam, wrote of this swamp as follows:

Several attempts have been made to cultivate the large swamp, or cieñaga, near Agaña, but they have not as yet proved successful. The swamp is but a foot or two above the level of high tide. It was once a lagoon.

In considering the question of reclaiming the swamp, an attempt was made to learn why previous efforts had been failures. Nothing had been left of any of these efforts except one made during the Spanish régime in 1883, when several canals were constructed, traces of which are still visible. The principal cause for failure was that the canals were too few and too far apart. The swamp, being but a foot or two above the level of high tide, can not be reclaimed by the customary system of drainage; its level will have to be raised. The best method for doing this without doubt would be that adopted in the so-called moor culture in Europe. By this method sand is distributed about a foot in depth all over the swamp, so that the soil can be worked with tools, and the plants secure their nourishment from the rich ground beneath. As this method was too expensive to carry on in Guam, it was modified in the following manner: Canals, 9 feet wide and 3 feet deep, were dug 36 feet apart, the earth of two canals being thrown on the plat of ground between them, so that this plat was raised about  $1\frac{1}{2}$  feet above the level. The next plat was kept at the usual level, and is to be planted with rice or taro. The third was raised again by throwing the soil out of the two canals, and the process continued. Two of the plats have already been planted with date palms, with Kafir corn between the rows of palms, another is planted with corn, while peas are planted on still another. Two of the low plats are now in rice and two in taro.

The canals may be used later to breed fish, and it is thought that gold fish would be especially adapted for this purpose, as they are not only good for food, but they feed on mosquito larvæ and would be beneficial in that way.

**ANIMAL INDUSTRY.**

The station's equipment of cattle consists of two bull calves, two full-grown bulls, and a carabao. One of the bulls is in poor condition, on account of its being infested with numerous ticks at the time it was secured. The other animals are in good condition and are used in drawing stone, etc., for a road across the swamp. The cattle had been broken to the plow and will be used for that purpose as soon as the reclaimed land becomes dry enough.

Experiments with chickens have been in progress for three years, and by continual hatching from the largest eggs obtained it has been possible to increase the weight of the eggs during that time from an average of about half an ounce to  $1\frac{1}{2}$  ounces each.

#### SALES OF PRODUCTS.

The proceeds of the sales of products of the station which were turned into the island treasury for the fiscal year 1907 were ₱1,032.73, as compared with ₱654.54 for the previous year. The total value of the products of the station during the fiscal year was as follows:

Deposited in the island treasury.....	₱1, 032. 73
Products given away.....	526. 57
Products exchanged for calf, etc.....	46. 85
Forage for the government stables.....	305. 76
Work outside the station.....	44. 58
Total .....	1, 956. 49

#### FUTURE WORK OF THE STATION.

The immediate necessity for information regarding vegetable growing having been settled, more attention will be given in the future to plants whose products are adapted to exportation. This is of especial importance, as there is a possibility that the cocoanut disease, caused by the scale insect, may reduce the exportation of copra. It is not to be understood that there is an immediate danger of such an occurrence. New plantations are coming into bearing as the old groves are destroyed by the insect, and many years may pass before the amount of copra produced will be materially decreased. The progress of the disease is rather slow. The young plants as a rule are not affected. However, a female scale may obtain lodgment on a tree where it will produce many generations of progeny in a comparatively short time. While the trees are young and growing rapidly the scale does not affect them to any serious extent, but there finally comes a time when by their abundance the vitality of the palm is checked, after which the destruction proceeds rapidly. The trees appear in a sickly condition, the fruits are crumpled, the leaves shortened, and finally the tree dies.

It is possible that through the assistance of the United States Department of Agriculture parasitic or predaceous insects may be obtained to feed upon this scale. For the present planters are advised to select large ripe nuts for planting and to place them for germination under almost any tree except a palm. In establishing new groves care should be taken that they are considerably removed from old cocoanut groves, and old trees should be cut down and the crowns burned. In planting new groves young trees should be set from 25 to

30 feet apart in each direction. If these suggestions are followed it is believed that the old groves will die out in the course of time and the source of infection will be considerably reduced.

As stated above, experiments will be continued with rubber-producing trees; seed selection of corn, onions, papayas, and such other plants as time and opportunity will allow; collections will be made of the insects of Guam and attempts made to learn which of them are pernicious to the crops and means by which they may be controlled; experiments with chickens; and the work on the swamp will be continued, and as the plats are drained they will be planted.

In order to protect the plantings of vegetables in the swamp, it will be necessary to build a house for a watchman. Part of the swamp adjacent to the hospital will be formed into a park, and additional portions of the hill behind the palace will be cleared and planted with cocoanut palms and other plants which are adapted to the dry situations. Some Ceara rubber is already planted there.

The station is in urgent need of plows and farm implements, the present stock being partly worn out, and most of the tools on hand are not intended for farm work, but for road building and clearing. Lumber for the corral is also necessary.

The attitude of the people toward the experiment station is quite encouraging. Dr. J. C. Willis, director of the Royal Botanic Gardens, Peradeniya, Ceylon, wrote in the *Tropical Agriculturist*<sup>a</sup> some time ago an article on improvement in village agriculture, in which he said:

Agriculturists, more especially southern Asiatics [and Pacific Islanders], are about the most conservative of mankind. Great harm has been done to the cause of true scientific and lasting progress by enthusiasts anxious to go rapidly, forgetting that the gap between the native and the European—if, indeed, it can ever be or is desired to be bridged—is to be measured in centuries.  
\* \* \* Instead of fixing upon a definite system and adhering firmly to it for long periods till it has had a chance of showing results, we treat it only too often as children treat the plants in their gardens, digging them up at frequent intervals to see how they are getting on, and soon throwing them away because they have not grown unnaturally quickly to suit their wishes.

Such statements regarding the people of one of the oldest and most advanced tropical colonies tend to make us content with the progress made in Guam, and the results thus far indicate that the people here are better fitted to take a lesson from the example set before them than the natives of most tropical countries. The Chamorros come to the station for good seeds; they ask for the inspection of their ranches and for information regarding the plants best suited to their places. This shows much more interest than was anticipated, and is quite satisfying for the present and augurs well for the future.

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<sup>a</sup> *Trop. Agr.* [Ceylon], 26 (1906), p. 269.

To extend the work of the experiment station to the villages the aid of the school-teachers should be secured. The presence of small house gardens around their dwellings or around the schoolhouses may be made use of. These gardens or ranches should be under the control of the teachers and could be supplied by the station with such plants as could be spared. In this way every village could soon have an experimental garden on a small scale with practically no expense to the school. These gardens could be visited occasionally and advice given the teachers about the best situations for their plants and the care which should be given them. The villagers, seeing the plants growing, would desire a few for trial, so that valuable plants would gradually come into local use all over the island.

Very respectfully,

H. L. V. COSTENOBLE.

Commander T. M. Potts,  
*Governor of Guam.*

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